ENGINEERING

THE UNIVERSITY
OF MICHIGAN
DEC 16 1959
ENGINEERING
LIBRARY

Engineering in Big Buildings

THE UNIVERSITY
OF MICHIGAN
DEC 16 1959
ENGINEERING
LIBRARY

Work in progress in the Merchant Mill section of the Rolling Mill area at Durgapur. As a member of ISCON, Davy-United are responsible for over a quarter of this new Indian Steelworks including all the rolling mills, the wheel and axle plant, the central engineering maintenance shops and the iron and steel foundry. The engineering and supply of all the 75,000 tons of machinery involved was co-ordinated by the Davy-United Construction Division.

ENGINEERING FOR Steelworks

The Construction Division of Davy and United Engineering Company Limited offers an overall engineering service to any steel maker planning a development project. Whether these plans cover the remodelling of an existing plant, the addition of new productive departments or even the layout and construction of a complete steelworks, Davy-United Construction's division will engineer the entire project, co-ordinate the supply of all equipment involved and assume full responsibility for the whole job. Alternatively, the division will undertake any part of a scheme in conjunction with the customer's own development engineers.

DAVY-UNITED

ISSUED BY THE CONSTRUCTION DIVISION OF—

DAVY AND UNITED ENGINEERING COMPANY LIMITED, SHEFFIELD, ENGLAND

334 DU

ENGINEERING

Vol. 188 No. 4884 27 November 1959

PUBLISHED EVERY FRIDAY

Contents

525 **Leading Article**
Building Big—and Better

526 **Plain Words**

526 **Weekly Survey**

527 **Letters to the Editor**
Management Selection
Heat Relationship
Fuel Consumption in Cars
The Caste System

531 **In Parliament**

532 **Meetings and Papers**

534 **Atomic Review**
Proposal and Disposal

536 **Special Articles**
Buildings with Many Floors

538 **Exhibitions and Conferences**

540 **Automobile Engineering**
Choosing an Economy Car Statistically

549 **Companies in the News**

553 **On the Shelf**

553 **Publications**
Materials and Methods of Architectural Construction
Plastic Design of Steel Frames
Proceedings of a Symposium on the Strength of Concrete Structures

554 **New Books and Trade Publications**

564 **At Home**
Switch Safely

528 **New Plant and Equipment**
Toggle Clamp, Tape Cassette, Dial Gauge, Contamination Monitor

The Building Exhibition
Concrete Mixer, Woodworker, Concrete Placer, Panel Saw, Saw Bench, Mixing Valve, Portable Router, Mobile Mixer, Band Saw, Loading Shovel, Panel Sizer, Fixing Gun.

533 **The Human Element**

539 **Construction**
Weekly News

550 **Research and Development**
Duration of Wind Loading on Buildings
Telephone Exchange Uses Computer Techniques
Vacuum Science Committee

555 **Metals and Materials**
Engineering Gelatine from Hide and Skins
Antistick with Adhesives, Phosphated Primer, Adhesive Resists Immersion in Tuluol, Avoid Sulphur Fumes when Burning Residual Oil

557 **Design**
Telling Astronomical Time
Developing a Material for Superheater Tubes
Design Picture Page
Aluminium Lamp Standards
Transformer with Aluminium Foil Windings

561 **Operation and Maintenance**
Omnivorous Engines Simplify Fuel Supply

562 **Production**
Better Welding Techniques
Aid to Arc Starting
Sorting Sheet Automatically

563 **Marketing**

541 **Engineering in Big Buildings**
Two Picture Pages
The Architect has Prime Responsibility
Tower Cranes Change Building Designs
New Building Techniques

ENGINEERING *Appointments Section faces page 548*

Building Big—and Better

IN ALL large cities, big multi-storey buildings are growing up. It is not only in the Londons and the New Yorks but in all the larger cities that twelve, twenty and 35 storey buildings are appearing. Many a city of less than a million people boasts its own "skyscrapers." Here in London one predominant argument has contributed to the growth of multi-storey buildings: the compulsion that exists to stay within established commercial areas and hence the high cost of land which, in turn, dictates a small ground area.

But these facts alone will not account for such buildings in the less crowded cities, where ground in the outskirts is cheap and uncluttered by existing buildings, and yet be but a few minutes in a comfortable car from the centre. By building high it is possible to cut the costs of construction. The high concentration of men, materials and machines—the three M's in economic building—reduces the overall cost of any project. But there may be yet another reason for choosing many floored buildings to house commercial enterprises: such an office block lends itself to symbolising the concept of the organisation. Just as the office has strata of management, so it can have floors in the building. Just as the chain of command moves up and down, so can the memoranda be sent from floor to floor. It is easier to consider the departments of a business stacked one upon the other than it is to relate them as unit buildings end to end and side by side.

But if the functioning of an organisation is improved by the positioning of its parts, then its relationship with the outside world must be expressed in its appearance. For a big store the façade must attract. Solidarity and permanence must be reflected in the headquarters of a bank or an insurance company. But there can be little that spontaneously suggests permanence in a material that has in fact not existed more than a few short years. The quality of endurance is not proved without the passing of time. Stone and timber had been worked for centuries before the great periods of architecture evolved. The choice of material was severely limited to the point where experience was deepest. Proportion and scale were the principles upon which architecture was founded. The present diversity of materials leads not to a tradition or style, but to a diffusion of experiment. Imagination is required not to deploy more and more of the offerings of the manufacturers but to choose only that which is good.

Here lies the difference between the architect and the engineer. Faced with a demand for a new structure the former begins from the point of an ideal respresenting what he would like to build if he could. The engineer, on the other hand, starts from the more pedestrian condition of what it is possible to do. In a modern building, where both must of necessity contribute, the result is an amalgam of the two. It is from the architect that the stimulus to advance must come whereas from the engineer will come the establishment of order and tradition. It is only as tradition is formed that character emerges and only then that an architectural idiom of the age will result.

Ultimately, however, the problem is one for the building contractor who has to execute the designs of the architect and the engineer. Technical progress in the building industry has notoriously lagged behind technical advance generally. Little attempt has been made to recruit top quality technical and administrative staff over the years. This has severely restricted the diffusion of ideas. In an industry that is still organised primarily around the small employer, craftsmen receive little opportunity to learn new methods once they get their apprenticeship behind them. For a dozen years after the end of the war productivity fell. There was nearly one-fifth less work done per man in 1955 than there was in 1938. Since 1955, however, the impact of new techniques has shown results, and net output per man has risen. Materials consumption has also increased, so there has been a real, if unspectacular, advance in productivity. It is within this period of the last four years that the ubiquitous tower crane has become the essential machine on the building site, far transcending in significance the differences between structural materials that might be employed.

We are in the mid-way of an architectural revolution. New materials have been produced in profusion over the last quarter of a century. The threat of even newer ones, or of old ones transmuted so that they will perform other, unexpected, duties stifles the chance of a distinct architectural form appearing. The challenge that faces the architect and the builder is not one of using the plethora of new materials and techniques, but of rejecting those that will not fit into the ultimate scheme.

Yet the contractor cannot resolve the architectural dilemma caused by the desire to build big. He, like the engineer, can only limit endeavour to that which is practicable. It is the architect who creates. But it is by cooperation of architect, engineer and builder that a 20th century harmony will be achieved.

Cover Picture.—*New headquarters for an oil company being built on site next to the Royal Festival Hall, London. The main tower will have 27 storeys and be 338 ft high.*

Plain Words

Science teaching is in a bad way. I am appalled to find that what is taught today is much the same as I was taught—10 or 20 years ago. Science has moved. Science teaching has stood still.

Science teaching is like science theory: both encompass a group of facts to which new facts are always being added. Existing facts are like round pegs of various diameters encircled by an elastic band. Some new pegs fit neatly into the spaces left between other pegs; but many have to be inserted by stretching the elastic band. Eventually, it can no longer take the strain—and snaps. When that happens it is necessary to find a new elastic band, theory, or teaching syllabus.

Science education has reached this critical condition. The syllabus, clogged with traditional material, cannot accept the new subject matter that the practical requirements of our age demand. There is no question of intelligibility: the basic facts of nuclear physics, electronics, operational research and rocketry can be implanted in the youthful mind as readily as quadratic equations.

What is the answer to this situation? Can we cram up-to-date scientific knowledge into an already overloaded system? Or can we find a new elastic band?

Last week, I happened at a luncheon to sit beside a man who had an answer. He was about to become the principal of a big technical college and had served as physicist and administrator at a research establishment. He believed that schoolboys' minds could retain far more than they were taught at present.

The approach which he proposed was greater emphasis on phenomena and less attention to theory. Teach what happens when an electric current passes through a wire; don't try to conjure up a connected theory of electromagnetism.

In school, mathematics has been a drag on science teaching. The policy has been only to teach such facts as could be interpreted by theories consistent with the students' current mathematical equipment. The physics syllabus thus waited on the mathematics master. But quantum mechanics and relativity, once assumed to be unteachable without a basis of advanced mathematics, embrace many phenomena well within the grasp of schoolboys.

Schoolboys with their prodigious memories can learn many more facts than they do at present. Later, when they go to university, and when their ratiocinative faculties are better developed, will be time enough for theory. With more facts at their command they will also have a sounder basis for abstraction. And those who take up engineering will likewise profit from a broader empirical foundation.

CAPRICORN

Weekly Survey

Money from Management Courses

The allegation that some management training courses have been set up for no better reason than that the institutions running them needed the money was made at the Harrogate annual meeting of the British Institute of Management. It was put forward by Professor Norman Hunt, of Edinburgh University's department of Education of Industry and Commerce, who added that other institutions were running management courses simply because competing bodies were doing so—" keeping up with the Jones's," said Professor Hunt.

No one is likely to quarrel with the Professor's remarks that it is difficult to estimate how many courses for present or future managers are now held or how many attend. It is also difficult for senior executives to know just where they will send a man and for what course.

The post-war recognition that there is something to be learnt in management has carried us to the point where the question is which institution to attend rather than whether there is a course to go to. The point has also now been reached, as Professor Hunt remarked, where it is necessary to ask whether all the management education facilities provided are relevant or even useful. " The market for management courses has been so buoyant that a course had to be very bad to fail. The feeding to mediocre students of pre-digested meals concocted from badly written books on management can only tend to bring the whole of management education into disrepute. This is a situation in which nothing fails like success," said Professor Hunt.

This is all very well, but is there any such thing as a mediocre student? Rather are there students who are in the hands of mediocre instructors or on the wrong course. Students from industry on management courses are not there solely for general education but for further extension of their skills. What perhaps is wanted is not only the critical and questioning attitude called for by Professor Hunt, but also self-discipline at the institutions in screening those it is willing to accept. Though this might hurt feelings and lose clients it is an essential if academic standing should ever be desired.

Until then Professor Hunt has a point when he recalls that Professor Argyris of Yale has drawn a parallel between the development of management education and that in the public health services. Early courses in public health developed from the suggestions of students and practitioners. As experimental evidence accumulated subjects of study were increasingly determined by the results of research.

Similarly in management studies, where objective knowledge is so limited, courses are to a large extent designed on hunches. Professor Argyris had quoted (" Executive Development Programs; Some Unresolved Problems," for the American Management Association) some of the assumptions on which human relations courses were often based. They included: a happy worker is a productive one, workers naturally resist change, they want to be understood, and to express themselves, they need to belong to groups.

As can readily be seen the only certainty about these assumptions are that they are only assumptions.

Wages—Round Two

Early next month the executives of the shipbuilding and engineering unions will be meeting at York to decide what they are to do about the employers' replies to the claims for shorter hours and increased pay.

After the shipbuiding employers rejected the pay claim but said that it might be possible to reduce the working week, Ted Hill, the boiler makers' leader announced that the claim will probably be renewed.

The shipbuilding employers, through Mr. G. H. R. Towers, president of their federation, had refused pay increases mainly on the grounds that the future for the industry is so unfavourable that no effort must be spared to bring the prices down. With the figures of future keel layings, and a rate of cancellation of orders ahead of new orders, Mr. Towers was making the expected reply. Unemployment is on the increase in the shipyards and the labour force has fallen by 16 per cent in the year up to the end of September. For that reason, if for no other reason, it is easier for the employers to say that if the unions will cooperate in improving efficiency it will be possible to do something towards shortening the working week.

When the unions began the current pressure for a shorter week, they were not primarily thinking of spreading around what work was available; but the future for those employed in the shipyards strongly suggests that this may become a dominant factor and that employers' fears of merely increasing overtime costs will be no more than memories of happier times.

Fact Finding on Strikes

So often has the charge been made that communists were responsible for unofficial—wildcat —strikes that it is intriguing to observe that the information being sought by the Trades Union Congress committee inquiring into such strikes does not as yet cover political elements.

More than one conjecture can be made with this, but none of them as interesting as those upon what replies the TUC's committee will get back from the Electrical Trades Union.

The committee has sent to the 186 affiliated unions four questionaires which when analysed will give a unique picture, through union officials' spectacles, of this side of the life of just over eight million workers. The four questionnaires deal with unofficial strikes, unofficial strikes that were later recognised, official strikes called by the union, and stoppages by other unions that affected members of a union not itself involved in the dispute.

It is unlikely that all the information these forms will probably produce will even be in, and it will certainly not be collated, before the committee next meets on 18 December. Some time next year it is possible that the inquiry will take on altogether more dramatic form if it hears oral evidence from shop stewards, local and national union officials, and perhaps certain unofficial strike leaders. The picture built up by the committee, which has made the questions in its forms cover as far back as January, 1956, could have the complexity that leads a Royal Commission to sit for years. Headline-making strikes that cost millions of pounds, such as the London Airport strike with its loss to BOAC of more than £1,000,000, and others in the docks, printing, the motor industry and shipbuilding, come within the period covered.

Leading union men appear to fear that continuance of sporadic strikes could lead British unionism to the impasse that French unions have reached.

While the committee has at last been getting its inquiry started the Foundry Workers union has been pricking with the facts what it calls in a statement by its National Council, " the exploitation of unofficial strikes by the Tories " during the election.

Of the total working days lost through industrial disputes in the first eight months of this year —4,747,000—the number accounted for by the print dispute, an official action in which the

union leaders led their members from start to finish, was 3,503,000; and of the remaining quarter of the total, a number were in strikes recognised by the unions involved.

The union's statement is not breaking new ground when it says that " Tory propaganda " is equally vicious against official strikes, as in the London bus dispute. What may cause eyebrow lifting in Labour circles is the suggestion that " more sympathetic " coverage of strikes by the *Daily Herald* and " a greater support by party leaders to workers in the struggle " would be " more helpful."

Holland Stops Coal Scheme

Holland comes pretty low down on any list of European coal producers. Among the six members of the European Coal and Steel Community it comes number five with 11·5 million tons a year. This puts it ahead only of Italy which produces barely a million tons a year, and way behind Germany with 133 million tons. At this rate it might be expected that the Dutch would be interested in increasing home supplies. And at one stage they certainly were. Four years ago when it looked as though the coal and energy shortage was going to be a permanent feature of the European economic scene, the state-owned coal mining organisation prepared plans for expansion. Work was started on a new mine, named the Beatrix after the Dutch Crown Princess, with the object of cutting coal imports. This scheme, like the proposed nuclear power station at Geertruidenberg, proved abortive.

The Beatrix mine is in the Limberg field on the German border. Some of the more convenient seams run under German territory and a fee of about £11 million was paid for the privilege of working these. The pit was planned on the most modern design and would have been one of the most up-to-date in Europe. Eventually it would have added 1·8 million tons of coal to Holland's annual output. Since 1955 when work started some £3 million has been spent on sinking the shaft and installing machinery. Now the management of the state mines has decided that it just is not worth spending any more. The reason is that production costs will be relatively high. With huge unsold pithead stocks across the frontier in Germany and Belgium coal mining has become highly sensitive to costs. Home production covers about three-quarters of Holland's coal needs every year. But like Britain and other countries of Western Europe, the Dutch are now using more oil.

Rotterdam, with the vast expansion of its oil refining capacity at Botlek and the planned expansion farther west at Europort, will become the biggest oil-port in North-west Europe.

Brno and New York

Britain is to be one of thirty exhibitors at the Second International Brno Trade Fair, which is to be held from 11 to 25 September next year. The other nations vary from Lichtenstein and Tunis to the Soviet Union. The United States is not among the exhibitors listed, although Canada is. The Czech buyers at the Second Brno Fair are likely to be most interested in machine tools and construction machinery.

Recent figures show that Czechoslovakia's most important external trade links during the Brno Fair were with Russia and Great Britain. Exporting softwood, machinery, consumer goods and non-ferrous metals to this country, Czechoslovakia receives in return from us machinery, mining equipment, motor cars, plastics, textile piece goods and chemicals. This year's Brno Fair was seen by almost two and a half million people, 13,500 of them from outside Czechoslovakia.

Earlier next year, in June, the British Exhibition in New York has the exhilarating aim of helping to raise the value of British exports to the United States in 1960 to $1 billion. The 1958 figure was $764·4 million and records are being broken this year. The exhibition will take all four floors of the Coliseum Exhibition in the heart of the city. The Dollar Exports Council and the British-American Chamber of Commerce in New York are backing the fair, with the support of the Government. The organisers, British Overseas Fairs, have a budget of £300,000.

It sounds a little late to say that this is the first full all-British exhibition to be staged in the United States, but it happens to be true. Late it may be, but the exhibition is certainly wide ranging. It will extend from light engineering to Scotch whisky, from the Royal Mint to cartoons.

Claim to Title

There is a direct significance for those in the engineering industries in the Professions Supplementary to Medicine Bill under which are to be set up eight new professional bodies. Those whose standards of education and professional conduct are to be the responsibility of the new organisations, each with investigating and disciplinary committees, are the chiropodists, dieticians, medical laboratory technicians, occupational therapists, physiotherapists, radiographers, remedial gymnasts and speech therapists.

All those concerned are in that special world of health in which the untutored member of the public cannot at first know whether he is in competent hands or not. The disciplinary powers, too, reflect the fact that those who practise these professions may find themselves in something of the special moral situation of which medicine and the law have the greatest experience.

These are points not reflected in the engineering profession. The possibility of a private person retaining a consulting engineer is remote. The dealings of engineers must be taken as being with clients or employers who know what they are about. Yet the Professions Supplementary to Medicine Bill is also concerned with protected, or registered, titles. Experience suggests that where the requirements of a registered title lift standards and responsibilities, so they also surely, if slowly, raise the status and earnings of those affected. The registration of engineers is a subject mixed with emotion, with opinions strongly held, with wide divergence of view. Less difference exists over the desirability of protecting the title Engineer, though whether this is possible or not commands no unanimity.

Both in what the public know of them and in the confidence which is reposed in them, the benefits to the chiropodists and speech therapists will in time be as significant as the benefit to the practice of chiropody and speech therapy. For other professions, where problems of a similar magnitude are argued over, the position is changed in that the growth in number and size of bodies enjoying the prestige of the registered title may well lessen the standing of those who still spend a part of their energies explaining themselves and their importance.

Stainless Steel in the States

Increasing use of stainless steel in and on British cars is not news. But, with increasing competition for steel firms being one of the certainties of the Outer Seven group, a recent convention in Detroit of the American Society of Body Engineers heard of new uses that should encourage steel men on both sides of the Atlantic.

Greatest attention was paid to an all-stainless steel silencer that had done two years' hard labour in Detroit city traffic. Taken from the parent automobile after 30,000 miles it was cut in half and seen to show neither corrosion nor deterioration.

Stainless steel is also being freely used on the 1960 American compact cars. American engineers have solved the problem of producing colour effects in stainless steel and have obtained a finish that is capable of being machined, deep drawn and formed without losing its coating.

Letters to the Editor

MANAGEMENT SELECTION

SIR, I suspect that your recent comment on specialised personnel selection in the Weekly Survey " The Battle for the Brains " was written with the tongue in the cheek (ENGNG, 6 Nov.'59, p. 431).

The suggestion that there will be a tendency for " the man who suits the agency " to triumph over the more individual " man who suits the job " was in part answered by the article on selection for management in the same issue (p. 435). Mr. H. E. Roff emphasised the need for first-hand knowledge of the company and environment in which the candidate will have to work.

Where selection arises as the result of a reorganisation assignment, it is my company's practice to have the resident consultant present at the interviews. Also we have found it a good policy to send interviewing staff " into the field " on routine management consultancy work at regular intervals. It can be accepted that most consultants are aware of the danger of using staff trained in selection techniques but lacking adequate industrial experience.

Yours faithfully,
E. L. G. ROBBINS,
Managing Director.

Industrial Administration Limited,
18 Thurloe Place, London, SW7.
17 November, 1959.

HEAT RELATIONSHIPS

SIR, It must have occurred to a number of people that thermodynamic relationships can be presented with much greater economy if a sensible temperature unit is chosen. For example, the ideal gas law is physically simply:

$$\frac{p}{\rho} = \frac{T}{m}$$

where p = pressure
ρ = density
m = molecular weight
T = temperature in consistent units.

In British engineering units T will have to be ft^2/sec^2, in metric units m^2/sec^2 (= units of energy per unit mass). Conversion to conventional units is:

$T\ [ft^2/sec^2] = 49{,}700\ T\ [^\circ F\ abs]$
$T\ [m^2/sec^2] = 9{,}630\ T\ [^\circ K].$

Other important thermodynamic properties, speed of sound a, enthalpy per unit mass i, and internal energy per unit mass u are now for a perfect gas:

$$a^2 = R\frac{T}{m}$$

$$i = \frac{R}{R-1}\frac{T}{m}$$

$$u = \frac{1}{R-1}\frac{T}{m}$$ (R = ratio of specific heats).

Thus also i and u are in ft^2/sec^2, conversion to Btu/lb weight being:

i or $u\ [ft^2/sec^2] = 25{,}100\ i$ or u [Btu/lb].

Specific heats and entropy per unit mass become non-dimensional constants in this system, which is eminently sensitible from a physical point of view. Other thermodynamical relationships now follow in the usual way (with no more difficulty than otherwise).

Note that the gas constant has been eliminated and the gravitational acceleration does not intrude, e.g. in the formula for the speed of sound. The aerodynamic properties of a perfect gas are completely specified by the two variables T/m and R.

Yours faithfully,
G. T. CSANADY.

School of Mechanical Engineering,
University of New South Wales, Sydney.
11 November, 1959.

Continued on next page

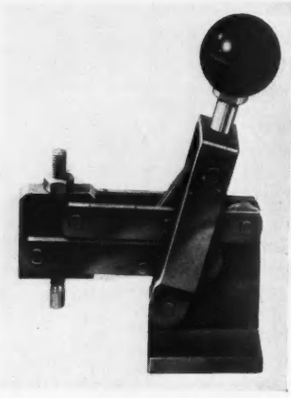
TOGGLE CLAMP

Vertical Closing

AN addition to the Speetog range is the ST210 vertical lift toggle clamp illustrated.

The position shown is just before final closure and the remaining movement of the clamping spindle is vertically downwards. The linkage is such that the spindle remains almost vertical throughout its entire travel, the last ¼ in being straight down. The great advantage is that it is possible to engage the spindle with a locating hole in the workpiece or fixture so that components can be located and clamped simultaneously. The clamp block that carries the spindle can be shaped to locate contours so that the lateral position of the component may be controlled at the same time as it is being clamped.

Another feature is that the clamp requires very little room for operation. A space 5¾ in between obstructions is sufficient. Alternatively as long as there is a clearance of 4 in behind the component there is room for the clamp.



As the clamping spindle lifts clear of the work the latter can always be removed vertically when the operation is finished. Similarly, it can also be inserted vertically. For special components, the spindle can be removed and the block machined to perform the locating and clamping. *Speed Tools Limited, Vereker House, Gresse Street, London, W1.*

TAPE CASSETTE

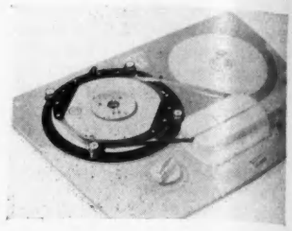
Continuous Play

A CASSETTE for recorder tape, the Brittape, has been produced to enable a continuous loop of tape to be played in a commercial tape recorder.

The cassette will fit any flat topped 7 in spool tape deck. It fits over either of the driving spindles while the loop of tape passes through the reading head. Any length of ¼ in tape up to 200 ft can be accommodated, and it can run in either direction.

When in use, the tape is drawn through by the normal driving mechanism of the recorder. Special control devices, the subject of a patent application, have been developed to ensure smooth running. A normal playing time of 22 minutes is given.

It is possible to double the effective length of the tape by the simple expedient of forming it into a Mobius loop so that a total of 400 ft becomes available. Experiments are being undertaken to provide for greater lengths to be handled. The existing cassette has been fully field tested.



The cassette is supplied complete with fitting instructions and loaded with 200 ft of tape. Smaller amounts can be supplied to order. It is necessary to specify the direction of play, whether from left to right or right to left, when ordering.

Suggested uses include the control of automatic processes; repetitive testing of switching mechanisms and sequence controlling devices; instructions to telephone networks; exhibition commentaries; recording of transient phenomena for later study; announcements in various languages, and the like. *Guy's Calculating Machines Limited, General Engineering Division, Truro Road, London, N22.*

Continuing Letters to the Editor

FUEL CONSUMPTION IN CARS

SIR, With reference to Mr. B. R. Goodfellow's letter (ENGNG., 20 Nov.'59, p. 496), he is of course quite correct in saying that my formula for m.p.g. is only approximate and refers to what one might call normal types of cars. One of the reasons why weight does not specifically enter into the formula is that, with normal types of cars, weight and engine size tend to some extent to go together. Probably even more important is frontal area, but again this has been omitted for simplicity.

Mr. Goodfellow mentions the discrepancy between the calculated figure for the XK 140 and the Mark VII, but, in fact, this discrepancy is not, I think, quite so serious as he makes out. His figure of 23 m.p.g. for the XK 140 is about 18 per cent better than the figure given by the formula, while *The Motor* test figure of 18½ for the Mark VII is 5 per cent worse. In actual fact, 18½ is rather poor for a Mark VII. The one which I had, used to do about 22, which is not so very different from Mr. Goodfellow's XK 140. There was a much bigger discrepancy in the case of the Triumph TR 2, which, by the formula, should have done only about 25 miles to the gallon, and, in fact, regularly did about 33 to 34: again, because of its light weight and small size.

My formula was derived by the simple process of plotting test values against cubic capacity. The curve which resulted suggested a formula in which a constant is divided by the square root of the capacity, and for this reason, I doubt whether the formula suggested in *The Motor* of 19 January, 1955, which is a cube root formula, is likely to cover the field so well; although, admittedly, it introduces the weight. As an example, this formula gives the values shown in the accompanying table.

It will be seen from this table that I have selected both large and small engines and heavy and light cars, and yet in practically every case my formula gives closer results than does the one mentioned by Mr. Goodfellow, and neither of them gives an accurate result in the case of the TR 2, mentioned above.

In view of the fact that m.p.g. depends so much upon driving conditions and driving technique, it seems unnecessary to go to anything more elaborate than the simple formula which I have put forward.

Yours Sincerely,
J. S. BLAIR.

3 East Carlton Park,
Market Harborough, Leicestershire.
23 November, 1959.

Car	Capacity, c.c.	Laden weight, cwt.	Actual m.p.g.	Calculated m.p.g.	
				Blair	*The Motor*
Jaguar XK 140	3,442	26	23	19·5	19·5
Jaguar MK VII	3,442	35	18·5	19·5	17·5
Austin A 40 ..	948	18½	38	37·0	33·2
Hillman Minx	1,494	23½	29	29·4	26·3
BMW	585	14½	46	47·0	42·2
AC	1,971	20⅛	22	25·6	25·3
Triumph TR 2	1,991	20	34	25·6	25·3

THE CASTE SYSTEM

SIR, Your Plain Words of 20 November strikes a useful warning note. The rapidly developing caste system probably owes its origin to the official definitions, accepted by the professional institutions, of a "professional engineer" and an "engineering technician" (See ENGNG, 21 Jan.'55, p. 69.)

As an ingenious combination of the worst features of Victorian snobbery with modern trades union restrictive practices these definitions would be hard to beat. One of the curses of the age is pigeonholing people into categories. We now have training courses for engineers and ditto for technicians.

The greater includes the less, and practical training courses for engineers and technicians should be the same, more particularly so in drawing office work, in which all engineers, whatever their ultimate specialisation, should take part.

The process of selection comes later. The engineers are those who can rise to higher things; but the best engineers are not by any means necessarily those who start with engineering degrees. These are not professional qualifications. Some of the ablest engineers I have known, both young and old, have had little, if anything, in the way of academic qualifications.

Yours faithfully,
HUGH CLAUSEN.

17 Harman Drive,
London, NW2.
21 November, 1959.

DIAL GAUGE

Extra Sensitive Range

THE series 300 are the latest additions to the Mercer range of dial gauges.

They operate on the lever principle and it is claimed that they are a technical advance on any existing gauges. Outstanding features are said to be their extreme sensitivity; the fact that they have no reversing lever in the mechanism; that the mechanism is geared throughout; and that the measuring pressure is under 1 oz.

To give optimum performance ball bearings or jewels have been fitted in all main bearings of the instruments. The body and the bezel have been finished in pearl chromium and the stylus, which is replaceable, is plated with hard chromium.

The instruments are sold in a plastics case and the standard equipment includes an adaptor for use with a height gauge and an adjustable screw for holding them in place.

The series consists of four models, differing in their reading and travel. Model 301 has a travel of 0·04 in and reads to 0·0005 in. No. 302 moves 1 mm and reads in 0·01 mm divisions. Model 303 reads in 0·0001 in and travels 0·008 in while model 304 reads 0·002 mm and travels 0·2 mm. *Thomas Mercer Limited, Eywood Road, St. Albans.*

CONTAMINATION MONITOR

Dual Phosphor

THE EMI portable contamination monitor type 1 is an all-transistor instrument employing the dual phosphor technique. It can be used for monitoring radioactive contamination on benches, clothing and similar objects.

Alpha and beta contamination can be monitored simultaneously, distinctive tones being used for each. An electromechanical register is included for low alpha activities. High accuracy is provided over a temperature range from 0 to 45° C, and by using a single switch it is possible to monitor the sum of alpha and beta contamination; alpha alone; or beta alone. This information is in the form of counts and is displayed on a meter covering the range from 0 to 5,000. The unit weighs 11 lb. *EMI Electronics Limited, Hayes, Middlesex.*

The Building Exhibition

The Building Exhibition that opened on 18 November at Olympia is the biggest of the series. More than 700 exhibitors are there, and the equipment on show ranges from bulldozers to beer handles.

Colour and decoration are much to the fore, including decorative glass, tiles, mosaics and wallpapers. In these fields the development of plastics materials has widened the possibilities far beyond the schemes of ten years ago. Equally enlarged is the range of contractors' machinery, designed to speed the work of erection and reduce the labour force, since in the building as in other industries it is labour costs that have risen most.

Some of the engineering items displayed were described in our issue of 13 November; some more are given here. The exhibition remains open till 2 December.

CONCRETE MIXER

THE 7T tilting concrete mixer has a designed height of discharge that will feed most small dumpers.

The drum is mounted with good clearance to enable the dumper to be brought right under it, and the body of the mixer is shaped to assist discharge. As the road wheels are in line with the feed and discharge, there is no side overhang of the skip or drum when in transit, and the mixer can be placed on the standard 3 ton Lo-Lode trailer.

Power is supplied by an air-cooled diesel engine of either Lister or Perkins manufacture. Hydraulic transmission is used to drive the drum through a totally enclosed worm-reduction gearbox and the skip is raised by a hydraulic ram. An integral hydraulic weighing equipment, a semi-automatic water meter, and a drag scoop are fitted. *Stothert and Pitt Limited, Bath.*

WOODWORKER
Saw, Planer, Mortiser

THE BMT is claimed to be a truly universal woodworking machine.

Operations that can be carried out on it include, sawing, tenoning, grooving, disc sanding, dovetailing, boring, planing, levelling and rebating. Two electric motors supply the power and either can be operated independently.

As a saw it will take a 10 in diameter blade and will cut up to 3½ in thick material. The table can be set at 45°. To the left of the saw the maximum rip is 7½ in and to the right is 14 in. The distance from the front of the table to the saw centre is 9¾ in. The ¾ h.p. motor runs at 2,850 r.p.m. giving a blade tooth speed of 10,000 ft per minute. Mitre slides and fences are available.

The planer section will take a cutter block 3½ in diameter and 6 in long. Its running speed is 5,000 r.p.m. The overall length of the planer tables is 36 in and the full cut of 6 in can be taken. Both tables are fully adjustable. A machined platform allows rebating up to a depth of ½ in. The fence has a length of 22½ in and can be canted to an angle of 45°. The driving motor is ½ h.p.

Horizontal and transverse mortising can be carried out, the sizes ranging from ¼ in to ⅝ in. There are adjustments for length, width, and depth, and automatic stops for both length and depth. A wide range of accessories includes a wobble saw and a flexible shaft drive. *Parry and Son (Tools) Limited, 329-333 Old Street, London, EC1.*

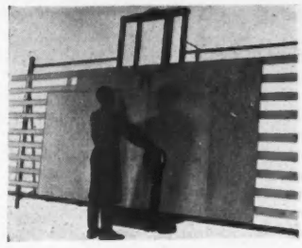
CONCRETE PLACER
Pneumatic Operation

THE Durogun is a machine for delivering concrete to laying areas at distances of 1,000 ft from the mixing point.

It consists basically of a hopper container, with lid sealing and valve gear to control air feeds, in which air pressure is built up to force concrete along a 4 in or 6 in pipe line. Opening and closing of the lid are controlled by the air pressure, and another valve controls the cleaning of the lid to ensure a seal.

Mixed concrete is fed into the hopper until it is three-quarters or seven-eighths full. Air from the compressor receiver cleans the lid, closes and seals it, and then as the pressure builds up forces the concrete along the line. Distances of 1,000 ft can be traversed and heights up to 200 ft with air at 100 lb per sq. in. At the end of the pipe run is fitted an air separator to remove any air entrained in the concrete and to ensure a smooth delivery. Speeds of flow along the pipe are between 5 and 8 ft per second. At this rate the full load is discharged in the time required for mixing the next batch, but the time of course depends on the length of run. The size of air compressor used and the volume of the receiver are regulated by the number and frequency of "shots." *Warsop Power Tools Limited, 27 Regent Street, London, SW1.*

PANEL SAW
Horizontal or Vertical Cuts



THE Holz-Her PKS panel saw will make horizontal or vertical cuts in panels up to 17 ft long by 6 ft 7 in wide.

The saw blade is mounted on a head which moves vertically on two columns. The head can be turned so that the blade is either horizontal or vertical as required. The height is controlled by the handwheel at the front.

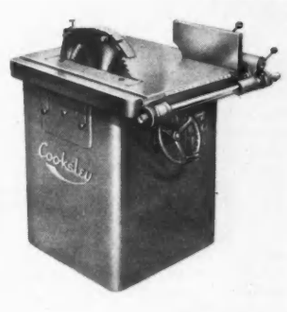
Panels standing on edge are laid against the support frame and rest on rollers at the bottom. The control handle bracket can be swung down to give full clearance at the front to allow for loading. Vertical cuts are made by winding the head downwards, and horizontal cuts by pushing the panel along. The head is counterbalanced for easy operation. The saw is equipped with a following support plate so thin material can be cut without distortion. A special attachment is available for use when cutting very thin veneers.

The saw is driven by a universal motor rated at 1·4 h.p. and the blade is approximately 8¼ in diameter; idling speed is about 8,000 r.p.m., falling to 5,000 r.p.m. at full load. The depth of cut is adjustable for panel thicknesses up to approximately 1⅝ in.

The whole machine in its standard form requires a floor space of 18 ft by 3 ft 4 in and stands 8 ft high. In addition to the free standing model shown, a form is also available for fixing to against a wall.

It is stated that changing the head from horizontal to vertical positions takes only a few moments and that the cable drive from the handwheel acts as slipping clutch to prevent faulty handling. *J. K. O. Cutters, Limited, Hughenden Avenue, High Wycombe, Bucks.*

SAW BENCH
Rising Spindle

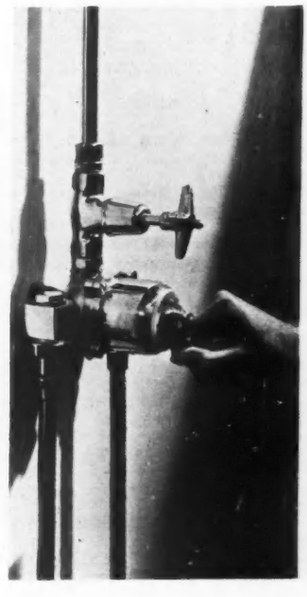


TWO new saw benches have been added to the Cooksley range. The smaller will take a 14 in rip or cross cut saw, and the larger will take one of 16 in. In both cases the table is 34 in by 27 in, is grooved to receive a mitre fence and has a removable gap plate. The canting and turnover fence which has a micrometer adjustment, gives a maximum capacity of 16 in between the saw and the fence and can be swung clear for cross cutting.

The main frame incorporates a dust chute and completely encloses the motor, the V-belt drive, and the lower portion of the saw. The drive is from a three phase motor of 3 h.p. for the 14 in model and 4 h.p. for the 16 in, with self-tensioning on the V belts. Control is by push button. The motor is normally supplied for 380-420 V 3-phase working, but single phase motors can be fitted.

The rise and fall of the spindle is hand controlled from a wheel at the front, and the saw is fully retractable below the level of the table. A cutter block or wobble saw can be substituted in place of the standard blade. Additional items that can be supplied include: 12 in crosscut saw blade; mitre fence with stop bar; drunken saw, 8 in diameter by 1¼ in bore with adaptor; Whitehill cutter block, 7 in diameter by ⅝ in by 1¼ in bore, with retaining washer; and an isolating switch fuse unit for mounting on the machine. *A. Cooksley and Company Limited, 21 Tabernacle Street, London, EC2.*

MIXING VALVE
Thermostat Control



THERMOSTATIC control of hot and cold water mixing is carried out by the Leonard 21 valve.

The 21 embodies the cartridge construction used in other models in the Leonard range. A particular feature is the regulating handle with a graduated scale plate. A wide temperature range and ease of selection are possible.

The element is a double coil bimetallic strip. The hot and cold water enter the mixing pillar through ports, the opening of which is controlled by a ported sleeve rotating outside the pillar. The sleeve is connected to the thermostat situated over the outlet of the pillar. Under normal conditions the temperature is maintained to within 2° F.

The thermostat assembly is self-contained and fits in the body in the manner of a cartridge. It can be removed by unscrewing the four cover plate screws. The valve is intended for small quantities of water at a fixed temperature. *Walker, Crossweller and Company Limited, Cheltenham, Glos.*

PORTABLE ROUTER

18,000 r.p.m.

THE Centec Senior router is a portable machine for hand operations.

Power is supplied by a 1½ h.p. motor which drives the cutter spindle at 18,000 r.p.m. The standard motor is rated for single phase supplies at standard voltages. Collets available will take ¼ in and ⅜ in shanks. The whole machine weighs 21 lb.

The spindle runs in grease packed ball bearings which are said to require no further greasing. The cut adjustment is calibrated in $\frac{1}{64}$ in and is fitted with a quick clamping arrangement. The total amount of adjustment for depth is ⅞ in.

There is a wide range of accessories available. There is a straight guide that can be set for any distance from 0 to 9½ in parallel to the guide edge and can also be used for edge moulding without a pilot on the cutter. A special base template with a plastics surface provides a guide bush for following templates for ornamental work and is required when the dovetailing and cross cutting attachments are in use. The latter enables grooves to be cut across boards up to 24 in wide and the former has the important feature that both male and female dovetails are cut simultaneously. The pitch is ¾ in.

Two cutters have been developed for cutting and trimming overhang on plastics materials. They have a ball bearing on the end of the spindle that guides the tool true to the edge of the material. Other attachments include a fixture for spindle moulding and an overarm router stand for repetition work. This has a work table 18 in by 18 in and a throat depth of 24 in. *Centec Machine Tools Limited, Centec Works, Hemel Hempstead, Herts.*

MOBILE MIXER

6 cu. yd Capacity

THE Mixer-Master is a mobile concrete mixer of 6 cu. yd capacity designed jointly by Blaw Knox and Crane Carrier Canada.

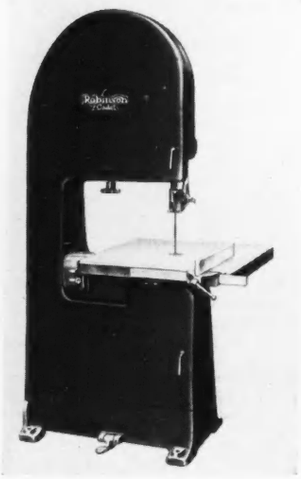
The Mixer-Master is a single-engined unit with the mixer driven from the Cummins C175 engine through a flywheel power take-off. With a full payload of concrete the vehicle weighs under 44,800 lb. It has a short wheel-base of 135 in giving it good manoeuvrability and without loss of accessibility to the working parts. The frame is all welded from rolled H-beams of alloy steel.

It is claimed that the cab gives the driver "control tower" visibility and by placing him at the outside of the vehicle gives better all-round vision. There is hydraulic steering on the front axle. Rubber mountings are used for the rear bogie and there is an interaxle third differential. A cab-controlled lock-out is fitted. The transmission is by torque converter, hydraulic multiple-disc clutch and five-speed synchronised gearbox. The flywheel power take-off eliminates the difficulties of front engine drive.

The 6 cu. yd drum operates on the Adjusta-Wate principle. It has a quick opening hatch and the water entry is through the bearing; discharge is at two levels inside. For discharge of the mix there is a 5 ft distributing chute with extensions of 4 ft and 3 ft available. The maximum spouting range is 16 ft. There are three lockable chute positions covering an included angle of 150°. Three alternative water systems are offered: a two-compartment syphon tank; flush tank; and pressure flush tank. The last can be either top or side mounted. *Blaw Knox Limited, 94 Brompton Road, London, SW3.*

BAND SAW

Fully Guarded



AN addition to the Robinson Cadet range is a 24 in band saw, type EY/E.

Chief features include the complete guarding of the saw, and the provision of guides both above and below the table. The main frame is a casting with swing-away doors to facilitate saw changing. These doors complete the enclosure of the saw blade. The body incorporates a dust chute that is placed to allow for connection to an exhaust plant.

The saw wheels are 24 in aluminium discs with vulcanised rubber rims. The bottom wheel has the 3 h.p. motor mounted directly on its spindle. An adjustable brush keeps the wheel free from sawdust. The upper wheel unit is carried in square slides for adjustment by handwheel and screw. A foot operated brake is fitted on the bottom wheel to give a quick stop.

The table can be tilted to an angle of 45° to the right and can be locked in position. An adjustable rip fence can be supplied. The saw can be 1¼ in wide and there is 13 in clearance under the guide. Saw pulley speed is 750 r.p.m. *Thomas Robinson and Son Limited, Rochdale.*

LOADING SHOVEL

Four Wheel Drive

THREE new loading shovels are now being made by Weatherill Hydraulic. They are all four wheel drive machines and are British designed.

The largest, model L64, is illustrated. It is powered by the Rootes opposed piston diesel engine TS3, which develops 108 b.h.p. The bucket has a heaped capacity of 2 cu. yd. The drive is through a torque convertor and a power operated Weatherill gearbox giving four forward and four reverse speeds up to 24 m.p.h. Two or four wheel drive can be selected as desired.

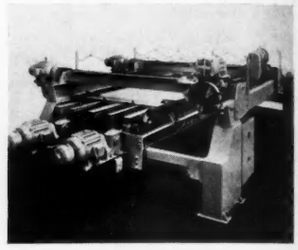
The discharge height is 11 ft 6 in. Steering is power assisted A patented system gives automatic scoop levelling with a preset digging angle, and the arrangement of the side arms allows automatic or hydraulic scoop crowding. The lifting capacity at safe working load is 5,000 lb.

Model L62 has a 1½ cu. yd bucket and is driven by a Ruston and Hornsby 85 b.h.p. air cooled diesel engine. Other features are as in the L64.

The L60 is the smallest of the three. It is powered by a Ford diesel engine rated at 62 b.h.p. at 2,250 r.p.m. The bucket is 1½ cu. yd heaped and the safe lifting capacity is 3 400 lb. For this load the maximum discharge height is 9 ft 6 in but it is possible to discharge at a height of 11 ft 6 in. As in the other models the drive is through a torque convertor hydraulically operated epicyclic gearbox and Weatherill transfer box. The scoop levelling system is not included in this machine. Accessories such as bulldozer blades, crane hook and scarifier are available for all three models. *F. E. Weatherill Limited, Tewin Road, Welwyn Garden City, Hertfordshire.*

PANEL SIZER

Four Edges at Once



ALL four edges of a panel can be trimmed simultaneously in the type ER panel sizing machine.

The standard machine carries four saw heads each driven by a 7·5 h.p. motor. Two longitudinal saws cut from the underside of the panel and the two transverse saws from the top. The machine can be arranged to carry one additional longitudinal and one additional transverse head for further division of the trimmed panels.

On the standard machine various sizes of panel can be accommodated, from 8 ft by 4 ft to 12 ft by 6 ft, but these can be varied to a minimum width limitation of 3 ft. The maximum thickness of panel that can be cut is 1¼ in, made up of either a single piece or a batch. The accuracy across diagonals is $\frac{1}{32}$ in.

The panels are fed on to the machine frame, where they actuate pneumatic trip valves that clamp and square them before the saws start their traverse. The transverse feed motors are each 1 h.p. but only a single 3 h.p. is used for the longitudinal feed. Standard feed and return speed is 60 ft per min. The cutting speed of the 14 in saws is 10,600 ft per min.

Power traverse of the sawing heads is by roller chains driven by totally enclosed worm reduction gears with both the worm and worm wheels mounted on Timken taper roller bearings. The motors are reversing. Control is by push button and the contactor gear is enclosed in a dust proof case. The saw heads can carry a hogging saw to break up the off-cuts to a size suitable for disposal through an exhaust system. *Thomas White and Sons Limited, Laighpark, Paisley.*

FIXING GUN

Safety Cocking

THE Spitmatic fixing gun has the cocking mechanism linked with the trigger so that it is not cocked until the trigger is pulled.

Power pins of ¼ in and $\frac{5}{16}$ in diameter are fired through the same barrel. Five cartridge strengths are available. The pins are fitted with a plastics cap which is said to ensure a square fixing together with improved penetration. The cap also removes carbon deposit from the bore and thus prevents wear. It is claimed that corrosive gases are unable to reach the working parts so that the need for stripping the tool is reduced.

Pins are loaded in the breech which opens automatically. No clamps or push rods are used. After firing the spent cap is ejected when the breech is opened; again no accessory is required. The firing mechanism release is operated by a permanent magnet. Initial movement of the trigger first cocks the striker but it is not released until the end of the trigger movement. The tool can thus be lightly held against the surface and does not need heavy pressure as is required when this causes cocking. *F. H. Bourner (Fixings) Limited, Manor Royal, Crawley, Sussex.*

REDUCING AIRCRAFT NOISE

Among the aircraft problems discussed in the House of Commons last week was the extent to which action was being taken by the Ministry of Aviation to reduce the noise nuisance of aircraft flying over residential areas on their approach to London Airport.

Mr. Anthony Royle (Conservative) said that, according to his information, there were no regular checks on the height of aircraft flying over his constituency, which included Richmond and Barnes. As many of these aircraft flew below the official limit of from 1,500 to 2,000 ft, he said he would like the Minister to institute regular height checks for aircraft flying within ten miles of London Airport. Mr. A. E. Hunter (Labour) referred to the personal visit recently paid by Mr. Duncan Sandys to London Airport for the purpose of studying the noise factor. The visit would be generally appreciated. He wondered, however, if the Minister was aware that residents around the airport were complaining that noise had increased considerably since October.

Mr. Sandys said that his interest in the problem of noise had begun some years ago when he was at the Ministry of Supply. It was no good pretending that the noise of aircraft could altogether be eliminated any more than could the noise of road traffic. What had to be done was to use every possible means to keep the intensity of the noise within tolerable limits and also to reduce as much as might be the size of the area affected. In order to keep aircraft at a reasonable height above built-up areas and thus to reduce noise, they were directed to descend at a prescribed minimum angle. He would look into the suggestion put forward by Mr. Royle regarding regular height checks.

CONTROLLING AIRCRAFT IN FLIGHT

Various Members raised points about the control of aircraft operating within the London Control Zone. Mr. John Rankin (Labour-Cooperative) wanted all these aircraft to be placed under the civil authority. Mr. William Baxter (Labour) asked that such aircraft, whether civilian or belonging to the Royal Air Force, should come under one control. A recent incident was quoted, where two aircraft approached near to one another during flight in foggy weather.

Mr. Duncan Sandys said that the newly-formed Air Traffic Control Board would keep this matter under review. In the case mentioned, the two aircraft were landing at different places, one at Northolt and the other at Heathrow but this did not alter the question of ground control. Whether RAF or other aircraft, the arrangement was that they were controlled jointly by an integrated system in the same building.

He told Captain George Chetwynd (Labour) that it was not a matter of which had ultimate authority between civil and military aircraft in cases of this kind. They were controlled jointly. Nor was it a question of which aircraft came in first. In the case referred to, he told Mr. Archie Manuel (Labour), one aircraft had been allotted one height and the other a height of 1,000 ft above it. The Government were trying to see whether they could not arrange for the two people who were controlling these aircraft to sit alongside each other at the same table.

CIVIL AVIATION IN EUROPE

An inquiry was made by Mr. F. J. Bellenger (Labour) about the extent to which agreement had been reached regarding the coordination, integration or preferential treatment of air transport services during the negotiations between the Outer Seven nations of the Organisation for European Economic Cooperation. He wondered if the Minister of Aviation were aware that negotiations were proceeding among the Inner Six nations for the integration between them of these services. He felt that if these Inner Six negotiations were successful, they would endanger the air services of the Outer Seven countries.

Mr. Duncan Sandys answered that the convention of the Outer Seven did not embrace the question of civil aviation. The negotiations had been quite complicated enough without adding any further subjects at the last moment. British European Airways already had very extensive pooling arrangements with all the main airlines of all the countries comprised in the Outer Seven group of nations.

EXPORTING BRITISH PERIODICALS

Proposals for cheapening the cost of sending British magazines overseas by air were put forward by Mr. John Hall (Conservative). He felt that those concerned should at least be persuaded to reduce the costs on technical and scientific journals and, possibly, on cultural journals as well—if " cultural " could be defined.

Dr. Charles Hill, the Chancellor of the Duchy of Lancaster, said that cheaper air mail and air freight rates would be helpful, of course, to the circulation overseas of British periodicals. But the major proportion of air mail rates consisted of charges made by the air carriers who transported the mail. The postal handling charges represented only a small proportion of the rate. For air freight, the carriers would allow a 50 per cent reduction in their rates for newspapers and magazines dispatched in consignments of more than 5 kilos. The fact remained, however, that up to 95 per cent of the cost of air transport was represented by the charges of the air carriers. The difficulties of distinguishing the different classes of periodical were great.

ATOMIC ENERGY AGREEMENTS

An inquiry regarding the extent to which there was cooperation between the United Kingdom and Canada in matters affecting research and development in the atomic energy field, was made by Mr. A. Woodburn (Labour). He pointed out that an agreement had recently been signed between Canada and the Euratom Authority from which Britain seemed to have been excluded. He felt that it would be a serious thing if Britain kept out of Europe in these matters, in order to retain the Commonwealth contact, while Canada and other Commonwealth countries united with Europe and left Britain out in the cold.

Sir David Eccles, the Minister of Education, speaking as representative for the Minister for Science, said that there had always been very close cooperation with Canada on matters relating to the development and research aspects of atomic energy. Meetings and exchanges of staff and information between British atomic personnel and the Canadians took place constantly.

Britain already had her agreement with the Euratom Authority. He was not aware that the Canadians had one on a different footing, but he would make inquiries.

EFFECTS OF HIRE PURCHASE

The latest figure of Britain's total hire-purchase debt was £784 million, as at the end of September. This total represented an increase of £303 million since September, 1958, when the first stage of de-restriction was announced, according to an answer by Mr. Anthony Barber, the Economic Secretary to the Treasury. He told Mr. Cyril Osborne (Conservative) that the movement of these figures could not, in itself, be taken as an index of inflation. There was no reason to believe that the restriction of hire-purchase facilities at this time would have any appreciable effect in reducing prices.

As to how much further the total of hire-purchase indebtedness could rise without endangering the stability of prices, it was expected that the increase in the nation's hire-purchase debt during 1960 would be very substantially less than the increase which had occurred during the current year. That decline would be a factor from now on in damping down the rise in the demand for goods. It was well known that price stability as a primary objective of Government economic policy was a matter that was uppermost in the mind of the Chancellor of the Exchequer. He did not think, however, that hire purchase in itself was a bad thing.

He agreed with Mr. Denzil Freeth (Conservative) that, provided that sufficient savings were forthcoming from the community, an increase in the nation's hire-purchase debt need not be inflationary. He also felt that Mr. Freeth was correct in his assertion that, per head of population, the hire-purchase debt in this country was still substantially below that in the United States.

Competition in Electric Cables

A suggestion that monopoly pressures in the cable-making industry were threatening to stifle fair competition was put forward by Miss Jennie Lee (Labour). In reply, Mr. F. J. Erroll, the Minister of State to the Board of Trade, said that he was aware that there was keen competition in the electric cable industry at the present time, that prices had fallen, and that some manufacturers were indeed complaining that prices were below cost. The Government were watching the position but there was certainly no ground for assuming that manufacturers were likely to charge unduly high prices in the future. The Government had power to refer these matters to the Monopolies Commission, but did not think that it would help to take such action at the present moment.

Improving Anglo-Russian Trade

A number of points were raised by Mr. R. Gresham Cooke (Conservative) concerning Britain's trade with the Soviet in consumer goods. In reply, Mr. Reginald Maudling, the President of the Board of Trade, said that quotas for the exchange of goods of this description, to a total value of £3,400,000 in each direction for the year ended 30 June, 1960, were agreed to between Britain and the Soviet Trade Delegation at the end of August. He understood that negotiations between United Kingdom trade interests and the Soviet trading organisations had been proceeding. Applications for import licences indicated that most interest was being shown in goods traditionally imported from the Soviet Union, but it was not the Government's practice to disclose the names of firms to whom import licences had been issued.

Outer Seven Affects Aberdeen

Attention was drawn by Mr. Hector Hughes (Labour) to the Outer Seven Free Trade Area Agreement having induced the paper-making industry in Aberdeen to reduce its commitments. In particular, one firm contemplated abandoning their plan to spend £750,000 on building a new high-speed paper-making factory at Inverurie, involving actual and potential loss to Aberdeen docks, railways, road haulage, engineering and related industries. Mr. John Maclay, the Secretary of State for Scotland, said that he was in close touch with the President of the Board of Trade regarding industrial and employment problems in Scotland and would write to Mr. Hughes about this particular case.

Zoning Systems in New Towns

A number of matters relating to the compulsory acquisition of land and to the ensuring compensation difficulties were brought forward. Mr. James Allason (Conservative) wanted the Minister of Housing and Local Government to re-examine the system of zoning within the designated areas of new towns, in view of the differing treatment afforded to persons whose land was compulsorily purchased. He was told by Mr. Henry Brooke that compensation for land in new towns, as for other land, was governed by the Town and Country Planning Act, 1959. That Act reflected the fact that value in the open market varied not with the use to which the land was actually to be put, but with the most valuable uses likely to be permitted. As that applied whether the land was in a new town or not, he did not consider that a re-examination of zoning in new towns was required.

MEETINGS AND PAPERS

British Institution of Radio Engineers

LONDON
Presidential Address by Professor E. E. Zepler. Annual General Meeting. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 2 Dec., 6 p.m.*

TREFOREST
"Wastage in Technical Education," by J. Cotterell. South Wales Section. Glamorgan College of Technology, Treforest. Wed., 2 Dec., 6.30 p.m.

Chemical Engineering Group

BRISTOL
"Beryllium Metal: Production, Properties and Applications," by Dr. G. A. Wolsten Holme. Chemistry Department, Bristol University, Woodland Road, Bristol 8. Thurs., 3 Dec., 6 p.m.

Helicopter Association

LONDON
"Aerodynamic Aspects of the Fairey Rotodyne," by K. McKenzie. Royal Aeronautical Society, 4 Hamilton Place, W1. Fri., 4 Dec., 6 p.m.

Illuminating Engineering Society

BIRMINGHAM
"The Association of Light and Colour," by A. D. Charters. Birmingham Centre. Regent House, St. Phillips' Place, Birmingham. Mon., 30 Nov., 6 p.m.

EDINBURGH
"New Data for Calculation of Coefficients of Utilisation," by W. Robinson. Edinburgh Centre. Y.M.C.A., 14 South St. Andrew Street, Edinburgh. Wed., 2 Dec., 6.15 p.m.

GLASGOW
"New Data for Calculation of Coefficients of Utilisation," by W. Robinson. Glasgow Centre. British Lighting Council, 29 St. Vincent Place, Glasgow, C1. Thurs., 3 Dec., 6.30 p.m.

HULL
"Fifty Years of Lighting Development," by J. W. Powell. Hull Centre. Offices of the Yorkshire Electricity Board, Ferensway, Hull. Tues., 1 Dec., 6.30 p.m.

Institute of Fuel

CARDIFF
"Coal, Gas, Oil, Electricity, Iron and Steel." South Wales Section. Brains Trust Meeting. South Wales Institute of Engineers, Park Place, Cardiff. Fri., 4 Dec., 6 p.m.

LIVERPOOL
"Automatic Boiler Control—for Comparatively Small Boilers." Discussion. Merseyside Sub-section. Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool. Thurs., 3 Dec., 7 p.m.

Institute of Information Scientists

LONDON
"Languages in Information Work: To What Extent is Competence in a Foreign Language an Essential Qualification for an Information Scientist?" Discussion, opened by J. Farradane and L. J. H. Haylor. Berner's Hotel, 10 Berners Street, W1. Wed., 2 Dec., 6 p.m.*

Institute of Petroleum

LONDON
"Europe's Energetic Forecasting," by P. Chantler. Wed., 2 Dec., 5.30 p.m.*

Institute of Refrigeration

LONDON
"Use of Refrigeration in Butchers' Shops," by F. R. I. Gerrard and J. A. Stonebanks. Institute of Marine Engineers, 76 Mark Lane, EC3. Thurs., 3 Dec., 5.30 p.m.*

Institute of Sheet Metal Engineering

BRISTOL
"Plastic Tooling." Discussion. South West Branch. Department of Engineering, The University, Bristol. Tues., 1 Dec., 7 p.m.

Institute of Welding

LONDON
"International Institute of Welding: Work in Hand." Theme at Conversazione. Fri., 4 Dec., 4 to 8 p.m. (Tickets required.)

Institution of Chemical Engineers

BIRMINGHAM
"Sieve Tray Performance at Reduced Pressure," by S. R. M. Ellis, P. E. Barker and R. N. Contractor. Midlands Branch. Midland Hotel, Birmingham. Wed., 2 Dec., 6.30 p.m.

Institution of Civil Engineers

LONDON
"Economic Assessment of Returns from Road Works," by G. Charlesworth and J. L. Paisley. Tues., 1 Dec., 5.30 p.m.*

BIRMINGHAM
"Jodrell Bank Radio Telescope," by H. C. Husband. Midlands Association. Joint Meeting with the local centres of the Institutions of Mechanical and Electrical Engineers. Midland Institute, Birmingham. Fri., 4 Dec., 6 p.m.

Institution of Electrical Engineers

LONDON
"Frequency Variations of Quartz Oscillators and the Earth's Rotation in Terms of the National Physical Laboratory's Caesium Standard," by Dr. L. Essen, J. V. L. Parry and J. McA. Steele. Joint Meeting of the Measurement and Electronics Sections. Tues., 1 Dec., 5.30 p.m.*
"Transmission of News Film Over the Transatlantic Cable," by C. B. B. Wood and I. J. Shelley. Thurs., 3 Dec., 5.30 p.m.*
"Nuclear Magnetic Resonance." Discussion opened by Dr. N. Sheppard and Dr. R. E. Richards. Medical Electronics Discussion Group. Fri., 4 Dec., 6 p.m.*

BRADFORD
"A System for the Automatic Recognition of Patterns," by Dr. R. L. Grimsdale, Dr. F. W. Sumner, Dr. C. J. Tunis, and Dr. T. Kilburn. North Midland Centre. Bradford Institute of Technology, Bradford. Tues., 1 Dec., 6.30 p.m.*

EDINBURGH
"Future Generation and Transmission Development in Scotland," by J. Henderson. South East Scotland Sub-centre. Carlton Hotel, North Bridge, Edinburgh. Tues., 1 Dec., 7 p.m.

GLASGOW
"Future Generation and Transmission Development in Scotland," by J. Henderson. South West Scotland Sub-centre. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Wed., 2 Dec., 6 p.m.

HOVE
"Provision of Adequate Electrical Installations in Buildings: (*a*) 'Houses,' by C. C. Hymans: (*b*) 'Multi-Storey Flats and Maisonettes,'" by C. A. Belcher. Southern Centre. Offices of the South Eastern Electricity Board, Hove. Wed., 2 Dec., 6.30 p.m.

NOTTINGHAM
"Electrical Machines," by Professor M. G. Say. Faraday Lecture. East Midland Centre. Albert Hall, Nottingham. Thurs., 3 Dec., 7 p.m. (Admission by ticket, gratis.)

Institution of Engineering Designers

BIRMINGHAM
"Diesel Engine Design Problems," by H. Haith; and "Manufacture and Design of Cold Rolled Sections," by C. Green. Midlands Branch. Queen's Hotel, Birmingham. Wed., 2 Dec., 7 p.m.

Institution of Heating and Ventilating Engineers

LONDON
"Off-Peak Electric Heating of Buildings by Hot-Water Methods," by S. A. Williams. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Thurs., 3 Dec., 6 p.m.*

NEWCASTLE UPON TYNE
"Warm Air Door Curtains," by J. N. Saunders. North East Coast Branch. Neville Hall, Westgate Road, Newcastle upon Tyne. Tues., 1 Dec., 6.30 p.m.

NOTTINGHAM
"Experiences in America," by C. S. K. Benham. East Midland Branch. College of Arts and Crafts, Waverley Street, Nottingham. Wed., 2 Dec., 6.30 p.m.

Institution of Highway Engineers

LEEDS
"Highway Lighting," by Granville Berry. Yorkshire and Lincolnshire Branch. Griffin Hotel, Leeds. Thurs., 3 Dec., 7 p.m.

Institution of Mechanical Engineers

LONDON
"Is High-Compression Ratio Worth Pursuing?" Automobile Division. Discussion. Tues., 1 Dec., 6 p.m.*
"Sealing Characteristics of Stuffing-Box Seals for Rotating Shafts," by Dr. D. F. Denny and Dr. D. E. Turnbull. Hydraulics Group. Wed., 2 Dec., 6 p.m.*

BELFAST
"Rubber Suspension," by A. E. Moulton. Northern Ireland Branch. Kensington Hotel, Belfast. Thurs., 3 Dec., 7 p.m.

MANCHESTER
"Mechanical Problems of the Electrical Engineer," by E. W. Consterdine. North Western Branch. Engineers' Club, Albert Square, Manchester. Thurs., 3 Dec., 6.45 p.m.

NORWICH
"Recent Developments in Lightweight High Output Air and Liquid Cooled Diesel Engines," by G. W. Bone and W. R. Dingle. Eastern Branch. Assembly House, Norwich. Thurs., 3 Dec., 7.30 p.m.

READING
"Bases of Measurement," by H. Barrell. South Branch. Small Town Hall, Reading. Thurs., 3 Dec., 7.30 p.m.*

SOUTHAMPTON
"Use of Mechanical Aids in Civil Engineering Industry," Discussion. Joint Meeting with the Southern Association of the Institution of Civil Engineers. The University, Southampton. Thurs., 3 Dec., 6.30 p.m.

Institution of Naval Architects

LONDON
"New Sea Trials on the Sand-Blasted Lubumbashi," by Professor G. Aertssen. Thurs., 3 Dec., 4.45 p.m.

Institution of Production Engineers

SOUTHEND
"Some Factors Affecting Cutting Tool Performance," by A. I. W. Moore. South Essex Section. Municipal College, Southend-on-Sea. Wed., 2 Dec., 7.30 p.m.

Institution of the Rubber Industry

LONDON
"Natural Rubber versus SBR." General discussion opened by W. G. G. Kellet, H. E. Davis, K. G. Burridge and K. T. Pickard. London Section. Manson House, 26 Portland Place, W1. Tues., 8 Dec., 7 p.m.

Institution of Structural Engineers

BELFAST
"Urban Motorways," by Lieut.-Colonel G. W. Kirkland. Northern Ireland Branch. Queen's University, Belfast. Tues., 1 Dec., 6.30 p.m.

BIRMINGHAM
"Light Alloys in Structural Work," by R. M. Davies. Midland Counties Graduates' Section. Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham. Thurs., 3 Dec., 6.30 p.m.

LIVERPOOL
"Model Analysis of Structures," by Professor A. W. Hendry. Lancashire and Cheshire Branch. The University, Liverpool. Tues., 1 Dec., 6.30 p.m.

MIDDLESBROUGH
"Design, Fabrication and Erection of Welded Girders for the South Durham Steel and Iron Co.'s Works at Greatham," by W. G. Gentry. Northern Counties Branch. Cleveland Scientific and Technical Institution, Middlesbrough. Tues., 1 Dec., 6.30 p.m.

YORK
"Economics of Framed Structures," by Donovan H. Lee. Yorkshire Branch. Royal Station Hotel, York. Thurs., 3 Dec., 6.30 p.m.

Junior Institution of Engineers

LONDON
Film Evening. Fri., 4 Dec., 7 p.m.*

Liverpool Metallurgical Society

LIVERPOOL
"Basic Aspects of Metal Fatigue," by Dr. T. Broom. Department of Metallurgy, University of Liverpool, 146 Brownlow Hill, Liverpool 3. Thurs., 3 Dec., 7 p.m.

Newcomen Society

LONDON
"Development of Engineering at the Royal Arsenal," by Brigadier O. F. G. Hogg. Wed., 2 Dec., 5.30 p.m.

Reinforced Concrete Association

LONDON
"Theory, Research and Practical Design of Reinforced Concrete," by W. E. J. Budgen. Wed., 2 Dec., 6 p.m.*

LIVERPOOL
"Further Developments in the Gifford-Udall Prestressing System," by E. W. H. Gifford and R. E. D. Burrow. North Western Branch. Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool. Wed., 2 Dec., 6.30 p.m.*

MANCHESTER
"Further Developments in the Gifford-Udall Prestressing System," by E. W. H. Gifford and R. E. D. Burrow. North Western Branch. College of Technology, Sackville Street, Manchester. Tues., 1 Dec., 6.45 p.m.*

Royal Aeronautical Society

LONDON
"Transonic Flow Over Swept Wings," by E. W. E. Rogers and Dr. I. M. Hall. Tues., 1 Dec., 7 p.m.

CHELTENHAM
"Some Servo-Mechanisms for Supersonic Aircraft, by S. G. Glaze. Gloucester and Cheltenham Branch. St. Mary's Hall, Cheltenham. Thurs., 3 Dec., 7.30 p.m.

Royal Meteorological Society

LONDON
"Meteorological Work at Halley Bay," by J. M. MacDowall. Junior Lecture. County Hall, SE1. Mon., 30 Nov., 5.30 p.m.

Sheffield Metallurgical Association

SHEFFIELD
"Clean Steel," by K. C. Barraclough. BISRA Laboratories, Hoyle Street, Sheffield 3. Tues., 1 Dec., 7 p.m.

Society of Engineers

LONDON
Open Discussion Meeting. Geological Society, Burlington House, Piccadilly, W1. Mon., 7 Dec., 5.30 p.m.*

Society of Instrument Technology

LONDON
"Discontinuous Skill Teaching Machines," by G. Pask. Data Processing Section. Manson House, 26 Portland Place, W1. Mon., 7 Dec., 7 p.m.*

CHELTENHAM
"Transistors": Film Display. Cheltenham Section. Belle Vue Hotel, Cheltenham. Wed., 2 Dec., 7.30 p.m.

FAWLEY
"Remote Supervisory Control and Plant Monitoring," by L. S. James. Fawley Section. Administration Building, Esso Refinery, Fawley. Fri., 4 Dec., 5.30 p.m.

MANCHESTER
"Instrumentation of the Dounreay Reactor," by K. R. Sandiford. Manchester Section. Central Library, St. Peter's Square, Manchester, 1. Tues., 8 Dec., 6.45 p.m.

SHEFFIELD
"Electro-Magnetic Flow Meters," by L. M. Bennett. South Yorkshire Section. The University, St. George's Square, Sheffield 1. Mon., 7 Dec., 7 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. Particulars for this feature should reach the Editor at least three weeks before the date of the meeting.

* An asterisk is placed where it is understood that refreshments are available prior to the time stated.

British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Chemical Engineering Group, 14 Belgrave Square, London, SW1. (BELgravia 3647)
Helicopter Association of Great Britain, 4 The Sanctuary, London, SW1. (ABBey 5160)
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215)
Institute of Fuel, 18 Devonshire Street, Portland Place, London, W1. (LANgham 7124)
Institute of Information Scientists. Apply to Mr. J. Farradane, Torran, Croft Road, Orpington, Kent.
Institute of Petroleum, 61 New Cavendish Street, London, W1. (LANgham 3583)
Institute of Refrigeration, New Bridge Street House, New Bridge Street, London, EC4. (CENtral 4694)
Institute of Sheet Metal Engineering, John Adam House, Adelphi, London, WC2. (TRAfalgar 6171)
Institute of Welding, 54 Princes Gate, Exhibition Road, London, SW7. (KNIghtsbridge 8556)
Institution of Chemical Engineers, 16 Belgrave Square, London, SW1. (BELgravia 3647)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Engineering Designers, 38 Portland Place, London, W1. (LANgham 8847)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Highway Engineers, 47 Victoria Street, London, SW1. (ABBey 3891)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Naval Architects, 10 Upper Belgrave Street, London, SW1. (SLOane 4622)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Institution of the Rubber Industry, 4 Kensington Palace Gardens, London, W8. (BAYswater 9101)
Institution of Structural Engineers, 11 Upper Belgrave Street, London, SW1. (SLOane 7128)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London, SW1. (VICtoria 0786)
Liverpool Metallurgical Society, Greenhithe, Grosvenor Road, St. Helens, Lancs. (St. Helens 5879)
Newcomen Society, Science Museum, Exhibition Road, London, SW7. (KENsington 1793)
Reinforced Concrete Association, 94-98 Petty France, London, SW1. (ABBey 4504)
Royal Aeronautical Society, 4 Hamilton Place, London, W1. (GROsvenor 3515)
Royal Meteorological Society, 49 Cromwell Road, South Kensington, London, SW7. (KENsington 0730)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7. (Sheffield 52865)
Society of Engineers, Abbey House, Victoria Street, London, SW1. (ABBey 7244)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)

Inventor Turns Salesman

The creative and scientific turn of mind of the inventor is rarely associated with the single-mindedness and opportunism of the salesman in the same human frame. This duality of skills is so rare that any evidence that it may exist is worthy of mention. The suspect is Mr. Edgar G. Knop, born in Berlin in 1928, educated in a natural sciences school and a graduate of Berlin University, where he read mathematics and theoretical physics from 1945 to 1946. Thereafter Mr. Knop had that look into the American way of life (and business methods) which was the privilege of so many of his countrymen in the late 1940's. He was trained as a radio communications engineer in Massachusetts and took a job in this grade with the United States Air Force in Germany as a civilian.

Mr. Knop's development as an inventor dates in the main from his joining the United States Department Civil Aviation Division for Germany at Frankfurt, after a two year spell with Pan American as a radio engineer on the ground staff, also at Frankfurt. As radio facilities engineer with the Civil Aviation Division, he designed a communications system automatic teletype. A long illness prevented his remaining in regular employment but gave him the opportunity to continue his studies and to do practical work in electrical engineering. In 1957 he was appointed development engineer with Telefunken in Germany where he worked on the development of semi-conductor circuits for railway communications systems and other applications. He holds some 15 patents, mainly on transistor circuits and including one for a portable transistor tester.

The sales job which Mr. Knop has now taken up is for one of the most market-conscious companies in the United States electronics industry, Texas Instruments Incorporated. He has been appointed technical representative in Germany and will be responsible for looking after the users of Texas Instruments' devices, reporting direct to Mr. Monroe Maller, manager European Operatjons, in Bedford, England. He has become technical ambassador, applications engineer, helper to users, in constant touch with the market which is currently among the most fertile ground for new ideas in engineering.

Electrical Summit

The misgivings of the unions in the electricity supply industry concerning the treatment likely to be meted out to their claims for a 40-hour week and a third week's holiday were voiced by their leaders recently during a meeting with Sir Christopher Hinton and Mr. C. R. King, the respective chairmen of the Generating Board and the Electricity Council.

Mr. Frank Foulkes, President of the Electrical Trades Union, and his colleagues, were said to be well pleased with the outcome of this summit meeting and went away with the feeling that their apprehensions concerning the industry's future were at least understood by the top employers. This followed the unions' failure to get replies to their claims from the industry's more junior negotiators. The meeting was reported to have been " lengthy, discursive and entirely amiable."

Guggenheim Medal

Sir George Edwards, managing director of Vickers-Armstrongs (Aircraft) Limited and the leader of the team that created the turboprop Viscount, is to add to his honours that of the Daniel Guggenheim medal for 1959. The award ceremony will take place in April next year.

The citation of the Board of Award referred to " a lifetime devoted to the design of military and commercial aircraft culminating in the successful introduction into world-wide commercial service of the first turbine powered propeller-driven aircraft."

A B.Sc.(Eng.) of London University, Sir George Edwards, now 51, joined the design staff of Vickers at Weybridge in 1935. Five years later he was the experimental manager, and another five years on, in 1945, the chief designer at Weybridge. Before the Viscount, Sir George was responsible for the Viking, the jet-engined Nene-Viking, and the flying classroom, the Varsity, and after the Viscount for the RAF's four-jet heavy bomber, the Valiant.

Living at Great Bookham in Surrey, Sir George gives his recreations simply as golf.

Patent Methods in Russia

Mr. Gordon Grant, Comptroller-General of the Patent Office, has gone to Russia on a mission that may be of resounding importance in the not so distant future.

Leading a small delegation, Mr. Grant has gone to discuss the protection available in the USSR for British inventions and to discover how the Russian system works out in practice. Russian patent law, as it was until recently, has been studied in this country and a number of firms have patents there, but the patent law has been revised and there is now a definite need for first hand information.

The fact that Russia is not a member of the International Industrial Property Convention to which most of the Western nations belong adds to the need.

Mr. Grant is accompanied by the assistant comptroller of the Patent Office, Mr. William Wallace, and by a director of Courtaulds, Mr. H. R. Mathys, who is a Fellow of the Chartered Institute of Patent Agents.

Higher Education in Africa

British money is pouring into the coffers of African educational authoritics. Another £1·4 million has been allocated to the University College of Rhodesia and Nyasaland for capital development over the five years from last April. The college was established in 1955, the foundation stone being laid in 1953 by the Queen Mother, who is its president. It is completely non-racial and students of all races use the same halls of residence, lecture rooms and playing fields. Last year 35 of the 169 students were Africans and one Asian.

The money has been made available from Colonial Development and Welfare funds on the recommendation of the Inter-University Council for Higher Education Overseas and the Colonial University Grants Advisory Committee. It is in addition to the £1,475,000 allocated in 1953 for the building of the college.

Foundry Health

A second report by the Joint Standing Committee on Safety, Health and Welfare Conditions in the Non-Ferrous Foundries has now been issued under the auspices of the Ministry of Labour and National Service (HM Stationery Office, price 1*s* 9*d*). This second report deals with specific medical problems and takes further the discussion of certain health matters dealt with in the first report. The committee deal particularly with problems arising from dust and fumes, and with certain health precautions especially against rheumatic disorders and heat exhaustion.

The committee say that their previous recommendations about the suppression of dust still stand and that there is greater need for their implementation since there may be more pneumoconiosis in non-ferrous foundries than was supposed. Illness from metal fume fever has decreased, but a high standard of control is needed in the use of beryllium, cadmium and chlorine. So far as heat exhaustion is concerned, this is unknown where the best working conditions are in operation, that is where there is a high fuel efficiency in melting furnaces. Saline drinks are recommended in establishments with less efficient or older furnaces.

Catering and Credit

The officer who long ago thundered forth at the " brutal and licentious soldiery " would have a hard time finding a link with the modern fighting man.

Hire purchase agreements and catering refinements play a greater part in a private's life it seems than do straw for paliasses or blanco for webbing.

The headquarters of the great catering establishment, NAAFI, have told Stott, the Oldham catering equipment makers, that their Inferation Units—heated display cabinets to the private citizen—have immensely increased the serviceman's demand for hot pies, sausage rolls and other warm snacks. The NAAFI as a place to assuage hunger shortly after an official cookhouse meal is apparently a thing of the past. Service messing has so improved that the NAAFI, with the aid of Inferation units, finds itself meeting a demand for supplementary snacks rather than major meals.

Taking these amenities in his stride the serviceman is providing experience for a firm who in a totally different setting, the uncompromisingly modern dining room and kitchen block of St. Anne's College, at Oxford, have provided the equipment for those catering for women undergraduates. While the kitchen here is a shining parade of stainless steel a more domestic note has been attained with crockery of primrose and grey.

And for the serviceman overseas, comfort is further cared for by, among other examples, the hire purchase facilities provided by the United Dominions Trust for buying motor cars. UDT say, surprisingly, that the larger part of their business in this way comes from the privates and corporals. Care is taken to see that the agreement entered into, for one to three years, does not go beyond the time the soldier (or civil servant) expects to be abroad. This is because if the car is the subject of a hire-purchase agreement, when it is brought back into this country purchase tax has to be paid. The thoughtful soldier can insure against this if he likes but very few do. The amount of this business is up three times on the same period of last year.

Strike Benefit?

Dispute benefit paid out by the unions last year dropped by about £1·5 million, according to the 1959 report of the Chief Registrar of Friendly Societies. In the previous year the London bus strike had been a heavy drain on the resources of the T & GWU. Its sales of securities to meet the bill were felt in the stock markets at the time. so it was said. Today the unions are in big business financially whether they like it or not. The miners perhaps rather do; they own significant quantities of ordinary shares and their views on nationalisation might be somewhat circumscribed in consequence.

The NUR has recently had a quiet but solemn reminder from its financial advisers that those unions have most room for manoeuvre who have a substantial bank account. Unions must think today in terms of millions of pounds. Their salary scales should keep more closely in step. Underpaid officials cannot be expected to think clearly in terms of millions of pounds when they run a danger of slipping on their weekly HP instalments.

XUM

Proposal and Disposal

FOR the first time since radioactive materials have come into use, Britain will have a uniform code for the disposal of radioactive wastes. A White Paper, published early in November, will form the basis of a proposed Radioactive Substances Bill, intended to replace the temporary legal structure which has been in effect since the war. The authors of the White Paper have adopted a commendably imperturbable attitude regarding radioactivity. Ultimately it is economics that determines the method of disposal. It is recommended that radioactive materials be treated as ordinary wastes whenever the money needed for special treatment could be employed in other fields with better results. The volume of low activity wastes may be so large, and the danger to the population arising from ordinary disposal so small, that a greater risk could be eliminated if the money were used to erect traffic lights, for instance, instead of treatment plants. Need for special legislation arises from two peculiarities of radioactivity: that radiation, although dangerous, is not a " nuisance " to the public and may go undetected for a long time; and that if a large population is exposed to radiation, the harmful effects may only become apparent in the following generations.

Magnitude of the Problem

If world consumption of electricity per capita were to increase to the present level in the United States, and if most of the electricity were to be generated from nuclear power stations, only about 1,000 tons of uranium would be consumed annually. In metal form, a cube with 12 ft edges would contain a year's fuel supply. It would appear that disposal of the fission products from such a small quantity of fissile material would not present serious problems. The difficulties arise not from the physical quantity of the materials but from the energy contained in the fission products and the form that this energy takes. If 1,000 tons of uranium 235 are consumed annually, and the fission products are allowed to " cool " for a period of one year, the equilibrium power level of the fission products will be about 2,400 MW(t), or a little more than the rated thermal output of a two-reactor station like Trawsfynydd or Hunterston. The feature that makes disposal of radioactive wastes so difficult is that most of the 2,400 MW of power is in the form of ionising radiation, not simply heat. The difference between the two forms of energy is illustrated by the fact that a lethal dose of radiation would raise the average body temperature by only 0·03° F, which can hardly be called a fever but nevertheless kills the victim. It would be a relatively simple matter to dissipate 2,400 MW of heat into the oceans, but it is vastly more difficult to dispose of material emitting radiation at the same level of power.

Long Lived Isotopes

The problem is further complicated by the presence of two long lived isotopes of strontium and caesium. If the fission products resulting from the annual consumption of 1,000 tons of uranium would be held in storage before disposal for twenty years instead of only one year, some 37 different isotopes would practically disappear from the mixed bag of fission products and leave only eight behind, but the activity would only drop by a factor of four. Half lives of caesium-137 and strontium-90 are 33 years and 20 years respectively, so that simple " cooling " is not a satisfactory solution to reduce the level of activity. Owing to the tendency of these materials to concentrate in certain plants, animals and portions of the human body, dispersal or dilution is a questionable practice. Fortunately, both isotopes are valuable as radiation sources in medical or processing applications and their disposal may not be necessary if a cheap separation process is developed.

Concentration

So far, fission products have been considered as if derived from pure uranium 235. In practice, a large proportion of power will be generated from natural uranium. A typical composition of 1,000 kg fuel irradiated to 1,000 MWD in a Calder Hall type reactor would be the following: 998 kg of uranium, 0·8 kg of plutonium and 0·98 kg of fission products. In order to separate the fission products from the fissile material, the entire amount—1,000 kg—has to be dissolved for chemical treatment. At the end of the process the fission products—0·98 kg—appear as a very dilute solution in a solvent from which 999 kg of uranium and plutonium has been extracted. The initial volume at the end of the extraction process is about 5,000 cu. metres per ton of fuel. As almost the entire radioactivity of the spent fuel is concentrated in the fission products, the solution is highly active and requires heavy shielding. E. Gluckauf estimates that storage of only 500 cu. metres of high activity effluent would require an annual expenditure of £60,000 (Long-term Aspects of Disposal, Geneva paper P 398). Concentration of the fission products is therefore essential.

Classification of Disposal Schemes

Two general methods of radioactive waste disposal are available. The choice depends on the nature of the waste, determined not only by its level of radioactivity, but also by the isotopic and chemical composition. The method of " dilution and dispersal " is applicable only to low-activity wastes which contain isotopes of low radio-toxicity. Radio-toxicity is a loose term which attempts to associate the potential radioactive hazard arising from the presence of an isotope to the metabolic function of that isotope in the body or its organs. The classic example is radio-strontium, which tends to concentrate in the bone structure owing to its similarity to calcium. As a result, it is considered to be highly radio-toxic. Highly radioactive or radio-toxic materials must be contained, and the accepted " ultimate " disposal is some form of tank storage after the material has been concentrated to an economical degree. In the United States the capital investment in storage tanks was $65 million, about the cost of a 200 MW(e) station, at the time of the second Geneva conference, and has increased considerably since. Alternatives to tank storage would be disposal in sealed containers, in deep oceans, and chemical fixing in some inert, non-leachable material which then could be stored in suitable geological strata. The possibility of shooting the most dangerous materials into space has not been mentioned so far, but may become the only internationally acceptable solution.

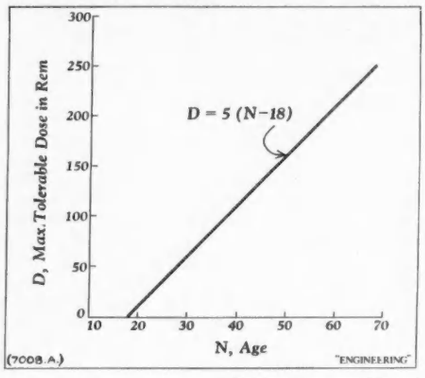


Fig. 1 (above) Relationship of age and tolerable dose.

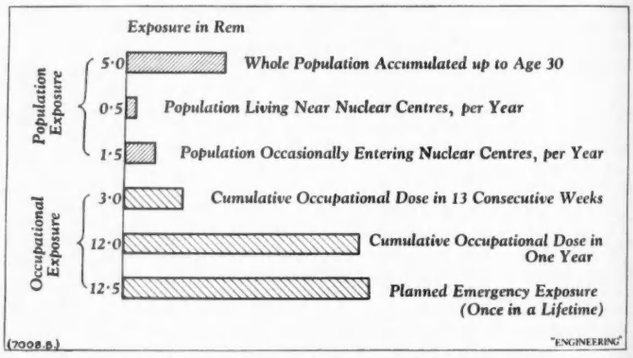


Fig. 2 (right) Comparison of tolerable population and occupational exposure.

Basic Standards of Protection

Ionising radiation is considered to have a cumulative effect on the human body on the one hand, and on the whole population on the other. Such a view has far reaching consequences on the method of establishing tolerance limits of radiation to which individuals or the population may be wilfully exposed. Average continuous exposure of individuals becomes a function of age: higher average exposure is tolerated at an advanced age when the individual's life expectancy is shorter. The formula for the calculation of the *maximum* dose is illustrated in Fig. 1. The genetic effect of radiation on the whole population is a complicated probability function that depends on the total " burden " of radiation carried by the population. Exposure of a limited number of individuals to relatively high doses of radiation will do little genetic harm owing to the assumed low probability of intermarriage among workers occupationally exposed. Fig. 2 illustrates the large difference in tolerated dosage for radiation workers and the general population. The anomaly between the tolerance level of the general population and the population living near nuclear centres arises from genetic considerations, and the higher level does in no way endanger the health of those whose home happens to be near an atomic research centre. The illustrated tolerance levels form the basic standard of radiological protection established by the European Atomic Energy Community. The UK Government White Paper recommends that waste disposal should be designed to prevent any member of the public receiving more than a tenth (0·03 r per week) of internationally accepted tolerance levels from radioactive wastes, and that the whole population on the average should receive less than 1 r per person in 30 years.

Recommendations of the UK Government

Gaseous, liquid and solid wastes are distinguished in the White Paper. For gaseous wastes, it is not considered necessary to filter the air exhausted from glove-boxes where open sources are handled unless the isotopes in question have high radiotoxicity, liquid wastes, which form a large proportion of the total, are potentially more dangerous owing to higher total activity and the possibility of biological or adsorption concentration. Components of sewage treatment plants may acquire dangerous radioactivity through continued use, endangering in particular the maintenance crews. Attention is drawn to the danger of uneven discharge of active matter, so that highly concentrated effluents may pass into the drinking water system even though the average rate of discharge over a longer period is well within permissible limits. Radio-active materials may enter a biological food chain if contaminated effluents are used as agricultural fertilisers, or contaminated rivers form a source of drinking water for cattle. Other food chains originate in water-cress or fish taken from contaminated waters. Disposal of solid wastes, provided certain limits of concentration and dosage are not exceeded, can be effected through the local authorities with the minimum of precautions. It is recommended that active wastes should be dumped so that they are immediately buried under at least five feet of refuse, giving adequate protection against later disturbance. Incineration is not recommended because it is difficult to control the conditions and equipment used by the local authorities. Burial is suitable only for short half-life nuclides even for nationally owned sites where there is adequate protection against future use. The most dangerous solid wastes should be dumped into the sea in suitable containers, and a national service for performing the task may be necessary.

Disposal in Ocean Trenches

There are nineteen deep-sea trenches in the oceans with depths exceeding four miles. Fifteen of the trenches are in the Pacific, one in the Indian and three in the Atlantic Ocean. It has been suggested that wastes could be dumped into such deep trenches and since the water does not circulate and mix appreciably with the rest of the ocean, radioactive contamination would not spread. Conclusions of Russian scientists, who have investigated the hydrology of the Tonga trench in the Pacific, indicate that mixing of the water in the trenches is fairly rapid both in the horizontal and vertical planes, and radioactivity would soon reach the upper layers of the

ocean. Consequently dumping should not be permitted unless the wastes are enclosed in containers designed to remain serviceable for a long time compared to the half life of the isotopes contained. (Disposing of Radioactive Waste in Ocean Trenches, by V. G. Bogorov and E. M. Kreps, Geneva P2054.)

Canadian Regulations

In Canada, where the division of power and responsibility between the federal and provincial governments is badly defined, no comprehensive legislation has so far been enacted for the control of radioactive wastes. In theory, the provincial governments are responsible for health and safety matters of local interests, and hence for the disposal of wastes anywhere in Canada with the exception of the two territories under the management of the federal government. In practice, there is close cooperation between the federal department of National Health and Safety and the provincial governments through the Atomic Energy Control Board, established in 1946. The legal basis of the board's power is the Atomic Energy Act, under which the board can regulate the handling and distribution of radioactive materials. Before any person or body is permitted to obtain or dispose of radioactive materials the board must be satisfied that the facilities and personnel of the user are suitable for the protection of public health.

Special Position of AECL

Treatment of the crown company Atomic Energy of Canada Limited is somewhat different as its operation is under the direct control of the federal government. Operations at Chalk River are supervised by three permanent committees which deal with reactor operation, criticality, and airborne contamination. Outside the confines of the Chalk River project the Environmental Research Branch of AECL study, but do not control, the spread of radioactive wastes.

Chalk River Waste Disposal

From the viewpoint of disposal, liquid wastes from Chalk River are divided into three groups according to activity. Wastes containing radioactive concentrations below the drinking-water tolerance are discharged directly into the Ottawa river. Where the tolerance level is slightly exceeded, the wastes are buried about two miles from the river and allowed to pass into the ground water. This method ensures that the liquid is sufficiently diluted by the time it reaches the river. High activity liquids are stored in steel tanks. All solid wastes are buried in designated disposal areas, but low activity wastes are left without containment, while highly active materials are placed into concrete or asphalt lined pits. The selected disposal areas drain through marshy ground into a small lake and eventually into the Ottawa River. The lake and its outlet, Perch Creek, are monitored continuously. The activity at the lake inlet has shown a steady rise since the summer of 1956, and towards the end of 1957 reached the maximum tolerance level. Fortunately the lake has sufficient capacity to dilute the wastes and the activity of the outlet has shown only a slight rise towards the end of 1957 amounting to 25 per cent of tolerance. Some concentration of active isotopes has been found in the fish of Perch Lake and also in animals trapped in the vicinity. The total discharge of active matter from the lake is about 1 millicurie per day, most of which reaches the Ottawa.

Radioactivity at Water and Sewage Works

Manchester College is giving a two-day course on problems of radioactivity in water treatment and sewage works. After introducing fundamental concepts of radioactivity, its measurement, its effects, and methods of radiochemical analysis, special lectures will deal with the problems peculiar to waterworks and sewage treatment plants arising from the discharge of radioactive wastes. The course will be held on 14 and 15 January, 1960.

More Waste Storage Tanks for Savannah Plant

A contract for four 1·3 million gallon radioactive waste storage tanks for the Savannah River plant has been placed with the Roberson Construction Company. The tanks are built underground, with an open top 85 ft diameter steel tank encased by prestressed " shotcrete " walls and concrete domed roof. The tanks, of which several are already in existance at the plant, cost approximately $400,000 each.

Waste Disposal Contractor

A commercial contractor, the California Salvage Company, has been licenced by the USAEC to undertake ocean disposal of low-level radioactive wastes on behalf of users of active materials. The licence imposes stringent regulation on material handling techniques. California Salvage will receive the wastes in its handling plant and encase it in 55 gallon steel drums lined with at least 3 in of concrete inside and outside. The drums will have a minimum density of 10 lb per gallon to ensure sinking, and will be labelled to indicate the origin, nature and activity of the isotopes contained. About 150 miles from the coast the drums will be sunk to a minimum depth of 6,000 ft.

Waste Disposal Licence Denial

The USAEC proposes to deny a waste disposal licence to Electro Chemical Laboratories " because of lack of demonstrated ability to guarantee maintenance and control of the burial site for an extended period of time."

Waste Disposal from Nuclear Submarines

Present regulation of the US Navy permit the disposal of liquid waste solutions without any restriction when the ship is at least 12 miles from shore. If the ship is in harbour or within the 12 mile limit, certain restrictions are imposed on the activity of the liquid wastes. Spent demineraliser resins can only be disposed overboard when the ship is in motion more than 12 miles from shore, when other ships are not within three miles, and when the ship is not in a fishing area. (Disposal of Radioactive Liquids from Nuclear Powered Ships, by J. M. Smith, Nuclear Engineering and Science Conference paper V-5.)

Notes and News

Energy Storage and Fuel Cells

Power generated during periods of low demand could be used to electrolyse water into hydrogen and oxygen as a form of energy storage, and reconverted to electricity in fuel cells. Fuel cells for the direct conversion of chemical into electrical energy are under development, and, if successful, could achieve a very high efficiency (ENGINEERING, vol. 188, 1959, p. 97). Allis Chalmers have recently demonstrated a 20 h.p. farm tractor using electrical traction and propane fuel cells as energy source. Although direct electricity generation from nuclear reactions is being studied at Los Alamos, fuel cells are closer to commercial exploitation. A further advantage is that the use of fuel cells does not add "unknowns " to the engineering of the reactor, which is itself a relatively new development.

Westinghouse Beach-Head in Belgium and Italy

Following the contract for supplying the reactor components of the Belgian reactor BR-3, Westinghouse have entered into an agreement with Belgium's largest electrical manufacturing company, the Ateliers de Construction Electriques de Charleroi, to manufacture pressurised-water reactors of Westinghouse design. A similar arrangement exists between Westinghouse and the Italian Fiat concern.

Soviet Fuel for High Burn-up

Gaseous fission product pressure of 1,400 lb per sq. in is resisted by the niobium-zirconium can of the fuel elements for Russian pressurised-water reactors. As a result of the high bursting strength, the 1 cm diameter uranium oxide filled elements are expected to reach very high burnup. Concentric tube uranium-aluminium alloy fuel for water-cooled reactors is also under development. The elements are tested in loops of a graphite moderated reactor with a neutron flux of 2 to $4 \cdot 10^{14}$. The pressurised-water reactors of the ice breaker Lenin are fuelled with bundles of narrow zirconium-alloy tubes filled with uranium dioxide. The tube bundles are surrounded by a zirconium alloy sleeve to form composite elements.

Direct and Indirect Gas Turbine Plants

Based on a helium-cooled graphite-moderated reactor core, a study group of the Hanover Technical University has developed two gas-turbine cycles for ship propulsion, one operating directly on the reactor coolant, the other through a helium-to-air heat exchanger. In the indirect cycle the maximum temperature is 1,275° F (690° C), which is just under the point where the efficiencies of gas-turbine and steam propulsion become competitive (Atomic Review, 18 Sept., '59). The theoretical thermal efficiency of the cycle is 28 per cent. Owing to the large surface area required by the gas-to-gas heat exchangers it was thought that a direct cycle might prove more advantageous for ship propulsion. Direct-cycle operation entails containment and shielding of the propulsion plant. In the Hanover study, a turbogenerator set is placed inside the reactor containment vessel. In order to simplify the construction of the turbine components—necessary to reduce maintenance—a very simple cycle was adopted with only 12 per cent thermal efficiency. Since for the same power output a considerably larger reactor core had to be provided, most of the space and weight saved by the elimination of the heat exchanger was lost. (*Jahrbuch, Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt, 1958.*)

Pressure Tubes Insulated with Compressed Powder

Heat losses to the moderator of pressure tube reactors, such as NPD-2 and Candu must be prevented. The problem is, where to place the insulation, on the inside or outside of the tube, and what form to use. If insulation is on the outside, the pressure tube has to operate at coolant temperature; if on the inside, pressure must be somehow transmitted through the insulation to the tube. At Chalk River an investigation of the use of powdered insulation on the inside of the tube has been undertaken. The insulating powder is separated from the coolant stream by a thin metal layer and the powder transmits the pressure to the tube. Of the powders tested—alumina, silica, talc and others—magnesia is the most promising. The material has relatively low neutron capture and low thermal conductivity, which, however, increases with compressive stress. (*The Internal Insulation of Reactor Pressure Tubes*, by D. H. Charlsworth, AECL-828, $1·00.)

East German Reactors

Construction work has started on Lake Stechlin north of Berlin, at the site of the first nuclear power plant to be built in East Germany. With a heat output of 250 MW, the reactor plant will supply 70 MW of electricity. Components will be supplied by the USSR. The work is in several stages the first of which will be completed in 1961. A 2 MW research reactor is in operation at the Research Centre for Nuclear Physics at Rossendorf near Dresden. Light water serves as coolant and moderator and the fuel is 10 per cent enriched uranium.

Nuclear Therapy

The Ministry of Health has approved plans whereby the Royal Marsden Hospital will build a new branch at Sutton Downs, Surrey, devoted to the application of nuclear energy in medicine. The project, which is expected to cost more than £1 million, will be situated within a large research organisation studying the effects of radiation on man.

Postscript to Explosions

It is reported that France's first nuclear explosion, which was planned to be held in the Sahara some time last month, is postponed till next February because of technical difficulties in the detonator and insufficient mass of plutonium.

Reclaiming Radioactive Milk

Methods for the removal of the radioactive isotope strontium 90 from milk products have been developed by the University of Tennessee. The ion exchange process using calcium based resins removes 94 per cent of the strontium without affecting the milk's calcium content. The process has so far only been tested on a laboratory scale and no estimate of costs is available.

Radioactive Wind from the East

Radioactivity measurements in the vicinity of Hamburg indicate that in the year 1956 the atmospheric activity was maximum when the wind direction was from the East and minimum when from the West. Considerable daily variations were observed, the average in May and June being 0·992 mr per day, and in July, August and September 0·650 mr per day. (*Atomkernenergie* 1, 393-6, Nuclear Science Abstracts 12331.)

Pooling Nuclear Data

Standardisation, unification and exchange of information will be the aims of a Nuclear Data Committee in which OEEC, the United Kingdom, Canada and the United States will participate. The committee will review existing knowledge on cross-sections and other nuclear constants and will promote collaboration and standardisation in the presentation of such data.

Workshops for Librarians

To aid librarians who look after the flood of publications on matters pertaining to atomic energy, the International Atomic Energy Agency is proposing to hold three-week workshops. Lectures and practical work on processing and handling publications will form the curriculum. A valuable by-product of the training will be uniformity of cataloguing and indexing in all libraries, a feature that research workers will appreciate.

Special Article

Buildings with Many Floors

Reinforced concrete or steel for the structural frame of multi-storey buildings? Precast concrete is used widely for flats. Lightweight aggregates are being used for structural concrete as well as for panelling. Glass in-filling panels look like displacing curtain walling.

With the increasing height of office blocks and multi-storey flats, architects and builders have had to call more and more on the structural engineer and the engineering industries. The building contractor has become more closely associated with the public works contractor.

In offices essential services have also multiplied: to heating and lighting has been added artificial ventilation; to outside and internal telephone systems are being added personal call systems using short wave radio; messenger services are being replaced by automatic internal postal services. Adaptabilityis the key to design. The disposition of the structural skeleton and of all the services are based on a chosen module. Internal partitioning that can be moved quickly to change the utilisation of floor space is the rule rather than the exception.

A few years ago the main framework of a five or six storey building had to be of riveted steel. Reinforced concrete was still suspect unless in the hands of a very small number of contractors and, in addition, the *in situ* placing of concrete in relatively small columns and beams was expensive in labour and shuttering materials. A shortage of steel forced the designer into reinforced concrete: the amount of mild steel rod required was less than the tonnage of rolled steel joists. Being faced with the compulsory use of reinforced concrete, the contractor—and architects—sought ways of cutting erection costs. Layouts were simplified and repetition increased in a way that it had never been considered essential with steelwork so that the multiple use of shuttering could be obtained.

Then began the use of precast concrete members, at first reinforced with mild steel rod and then prestressed with high tensile wires. Led and encouraged by the Cement and Concrete Association, the building industry began to make better concrete. Well designed mixes with graded aggregates and a good water-cement ratio replaced cement slosh. In the last 10 years concrete strengths on site have increased threefold. The position has been reached where the capacity of the concrete to carry load has ceased in many cases to be the criterion that dictates member dimensions. Lightweight concretes—based on pulverised fuel ash for aggregates and with densities around 100 lb per cu. ft—are coming into use for load-bearing members, as well as for panel fillings.

For the construction of flats structural concrete, almost entirely prefabricated, has been the rule for several years now. For office blocks—and university buildings—steel has never been fully displaced, not even when it was at its shortest. The signs are now that there will be a return to structural steel for multi-storey construction for commercial buildings. The new broad flange beams and column sections that Dorman Long are rolling—and Frodinghams will be in a year or so—offer a more economic use of steel tonnage than the old British Standard I-beams.

STEEL ADVANTAGE

Generally speaking the constructional steel industry has been slow to take advantage of the work of Professor Baker and his assistants at Cambridge University on plastic design. At first it seemed that the use of collapse theories merely altered the distribution of the steel, taking it away from the beams and putting it on to the stanchions. The work of the British Welding Research Association on stiff joints is aiding and abetting a return to steel. It is true that the work of the Association would seem more directly applicable to large-span structures such as turbine houses and factories, but such work must surely bring in its train more general use of steel for building frames. Moreover, it has already been pointed out that the tendency is towards large unbroken floor areas which, in turn, means bigger spans where steel has a number of advantages over concrete, whether reinforced or prestressed.

The use of high tensile steel bolts for making connections also simplifies site work as compared with riveting and is another pointer towards a return to structural steel. A British Standard has recently been issued for the bolts themselves and another is being prepared on the use of the bolts. Experience with high tensile steel in bridgework and for building frames on the Continent, particularly Germany, cannot have gone unnoticed.

Some way ahead there is the possibility of using adhesives for making steel connections.

" Meridian "—sculpture for State House.

(The aircraft industry has successfully used adhesives for several years now when bonding their structures and some experimental lengths of railway track have been similarly bonded in the United States without failure; the argument for trying glued steel connections is not so very far fetched.)

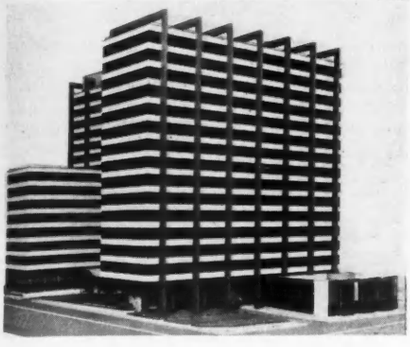
Fire resistance is still one of the outstanding problems to be tackled. Quicker and cheaper ways are still required of putting heat insulation around steel members so as to delay collapse in the event of a high temperature fire. If the risk of a high temperature fire ever developing could be eliminated, then both steel and prestressed concrete would gain.

For the construction of flats, concrete, in all its many forms, seems to be well established. The London County Council have led the way in this country with their " mixed developments " which have included point or slab blocks anything from 11 to 15 or more storeys in height, combined with maisonettes and houses. A paper prepared in 1955 by the Building Research Station showed that from five storeys upwards reinforced concrete was the cheapest material.

The model on the left is of Shell's new office on London's South Bank, with traditional cast stone walling hung on a steel framework. On the right is a model of a Soho building to be built by Wates. It has a reinforced concrete frame; below the windows are panels of vitreous enamel.

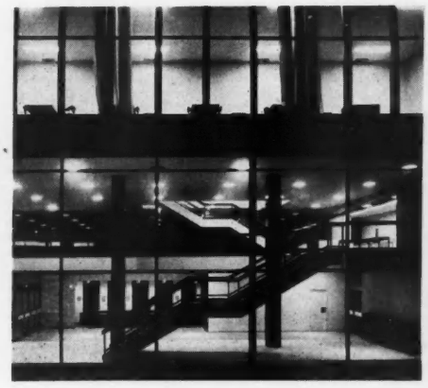
Changes in prices since 1955 can hardly have altered that opinion. The difference between flats and the open-floor office block is the number of permanent interior walls required in the former and here prefabrication and light aggregate in-filling are showing to advantage.

There has also been a vast amount of work done on the colour and pattern of finished concrete. The use of white concrete, using white cement and light-coloured aggregates, has been developed with success, particularly in Denmark. Coloured cements are more expensive than ordinary Portland, but they can be used with great effect in combination with exposed aggregate treatments. The general blotchiness of ordinary concrete, frequently disfigured by iron stains, can be hidden by painting which can also be used to emphasise patterning obtained from shutterwork. Apart from colouring, either by special cements or painting, a great variety of finishes of varying cost are available with exposed aggregates. The oldest method is that of bush-hammering which, in conjunction with well chosen aggregates, can be made to give delicate colours ranging from grey to light brown and pink. Sand blasting and rendering are other ways which have been used with success to break up the expanse of a concrete surface. The cast stone industry is not new and precast facing slabs have been used for 30 or more years to obtain a traditional exterior, especially for office blocks. Such slabs offer something of a weight problem but here again, the new lightweight aggregates used in well designed mixes may make for new developments.



State House, with its external columns.

Castrol House, with curtain walling.



On the right is Sheffield College of Technology which has curtain walling. The newer Sheffield University library (above) has in-set window panels leaving the structural frame well defined.

Over the last five years there has been a widespread preference for curtain walling for multi-storey offices. Such an example is the new Castrol House in London which the Wakefield Oil Group took over as their headquarters earlier this month As the adjacent illustration shows, the building is characterised by a 12 storey tower block (15 floors in all) which is clad in natural anodised aluminium and glass. On the advice of the Aluminium Development Association the anodising has been taken to a depth of 0·001 in to defeat corrosion of the HE9 alloy that has been used.

The curtain walling to the tower block consists of the aluminium grid, mullions, sills, with vertical sliding sash inserts, the top sash being black anodised. The spandril panels are of $\frac{1}{4}$ in Calorex glass and are fitted with cold cathode floodlighting that will give the effect of a series of lit trays at night.

Detailing of the walling has been done in such a way as to allow the greatest amount of vertical and horizontal expansion that occurs with an extreme temperature difference. Each section of the wall slides within itself and all expansion joints are concealed by spigot fixings between transome, cill and mullion; the mullions are also fixed in lengths of about 12 ft. Altogether a differential settlement of $\frac{1}{2}$ in was anticipated between the tower and the lower storeys as the building was completed. This had to be allowed for by leaving sections of the fixing loose until the final settlement had occurred.

CURTAIN WALLING ON THE WAY OUT

Despite all these allowances, curtain walling still raises a number of problems. There can be a drop of 40° F in the air temperature in England in August between early afternoon and early next morning. Such changes cause serious differential movements across a large expanse of walling on a large multi-storey building. Many cases have been recorded of glass being broken and far more reported of broken seals with consequent entry of rain and dirt.

It is such difficulties as these that are causing a trend away from curtain walling and towards large glass in-fillings. This movement can be traced in the changes made between the building for the Sheffield College of Technology and Commerce (with curtain walling and completed some time ago) and the new Sheffield University library, just completed, with large windows built between, rather than outside, the structural framework. In both cases the architects (Gollins, Melvin, Ward and Partners), engineers (W. V. Zinn and Partners) and the window manufacturers (Mellowes and Company) were the same. The two buildings are illustrated above; both exhibit the lightness that a large building demands, but the university library avoids the risks inherent in curtain walling.

Whether or not curtain walling is used, the fashionable use of glass or vitreous enamel externally makes for one frequent task not previously associated with the outsides of buildings: cleaning. The usual plan is to sling travelling gondolas from rails cantilevered beyond the roof line. To prevent chafing of the face of the wall, the gondolas are equipped with buffers. The use of such an external cleaning system for curtain walling is dictated by the difficulty of providing openings that would permit cleaning from the inside.

Different again from the buildings already mentioned is State House now nearing completion in London's High Holborn. It has, as may be seen from the photograph above, two 16 storey blocks built inside large reinforced concrete portal frames. This arrangement leaves the external walls completely free of columns so that internal partitions can be erected at any multiple spacing of 4 ft 2 in, the module adopted for the building. The main cladding is to be 4 in thick Portland stone facings that are to be used as permanent shuttering for the internal lining.

And to complete State House there will stand outside the main entrance a sculpture called "Meridian." Abstract in conception—it is illustrated on the opposite page—it is a series of curves in space which, the designer says, is to "emphasise the qualities of human scale in relation to the architectural setting."

LCC flats at Roehampton.

Exhibitions and Conferences

This list, in chronological order, appears in the last issue of each month. Events noticed for the first time and alterations of dates, places, etc., are indicated by an asterisk(*). For details of events not included below, reference should be made to ENGINEERING, *25 September, page 243, and 30 October, page 403. Organisers are invited to send particulars of coming events to the Editor.*

Iron and Steel Institute, Autumn Meeting.—Wed., 2 Dec., to Fri., 4 Dec., in London. Institute's offices: 4 Grosvenor Gardens, London, SW1. Tel. SLOane 0061.

Institute of Marine Engineers, Conversazione.—Fri., 4 Dec., at Grosvenor House, London, W1. Institute's offices: Memorial Building, 76 Mark Lane, London, EC3. Tel. ROYal 8493.

Supervisors in Industry, Residential Course for.—Sat., 5 Dec., to Sat., 12 Dec., at Madingley Hall, Cambridge. Apply to Mr. F. V. H. Ramsbottom, Board of Extra-Mural Studies, University of Cambridge, Stuart House, Cambridge. Tel. Cambridge 56275.

Display and Screen Printing Exhibition, Third.—Mon., 7 Dec., to Thurs., 10 Dec., at the Washington Hotel, 6 Curzon Street, London, W1. Organised by the Display Producers and Screen Printers Association, 28 Ely Place, London, EC1. Tel. HOLborn 1746.

Smithfield Show and Agricultural Machinery Exhibition.—Mon., 7 Dec., to Fri., 11 Dec., at Earl's Court, London SW5. Apply to the exhibition manager, Smithfield Show Joint Committee, Forbes House, Halkin Street, London, SW1. Tel. BELgravia 6611.

***Building Industry, Conference on Provision of Information in.**—Wed., 9 Dec., at the Connaught Rooms, Great Queen Street, London, WC2. Organised by Aslib (formerly the Association of Special Libraries and Information Bureaux), 3 Belgrave Square, London, SW1. Tel. BELgravia 5050.

***British Institute of Radiology, Annual Congress and Exhibition.**—Thurs. and Fri., 10 and 11 Dec., at Church House, Great Smith Street, London, SW1. Offices of the Institute: 32 Welbeck Street, London, W1. Tel. WELbeck 6237.

Studies in Seismic Engineering, Conference and Exhibition.—Thurs., 10 Dec., to Sun., 13 Dec., at Messina, to mark 50th anniversary of the Messina earthquake. Conference offices: Palazzo Zanca, Messina, Sicily.

World Agriculture Fair, First.—Fri., 11 Dec., to Sun., 14 Feb., 1960, in New Delhi. Offices: Exhibition Grounds, Mathura Road, New Delhi.

POWDER METALLURGY

***Powder Metallurgy of Magnetic Materials, Symposium.**—Wed., 16 Dec. (9.30 a.m. and 2.30 p.m.), at Church House, Great Smith Street, London, SW1. Organised by the Institute of Metals, 17 Belgrave Square, London, SW1. Tel. BELgravia 3291.

Boat Show, Sixth National.—Wed., 30 Dec., to Sat., 9 Jan., 1960, at Earl's Court, London, SW5. Organised by the Ship and Boat Builders' National Federation, 23 Knightsbridge, London, SW1. Tel. BELgravia 6402.

" Model Engineer " Exhibition.—Wed., 30 Dec., to Sat., 9 Jan., 1960, at the Royal Horticultural Society's new hall, Greycoat Street, London, SW1. Organised by The Model Engineer (Percival Marshall and Co., Ltd.), 19-20 Noel Street, London, W1. Tel. GERrard 8811.

Camping and Outdoor Life Exhibition.—Sat., 2 Jan., to Sat., 9 Jan., 1960, at Olympia, London, W14. Organised by New Homes and Trades Exhibitions, Ltd., Exhibition House, Spring Street, London, W2. Tel. AMBassador 5421.

Recent Mechanical Engineering Developments in Automatic Control, Symposium.—Tues., 5 Jan., to Thurs., 7 Jan., 1960, at 1 Birdcage Walk, London, SW1. Organised by the Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. Tel. WHItehall 7476.

Toy Fair, 11th International.—Sat., 9 Jan., to Fri., 15 Jan., 1960, at Harrogate. Organised by Harrogate International Toy Fair Ltd., Finsbury Court, Finsbury Pavement, London, EC2. Tel. MONarch 8921.

Electronics, Sixth National Symposium on Reliability and Quality Control in.—Mon., 11 Jan., to Wed., 13 Jan., 1960, at the Statler Hilton Hotel, Washington, DC, USA. Information obtainable from Mr. R. Brewer, Research Laboratories, General Electric Co., Ltd., Wembley, Middlesex. Tel. Arnold 1262.

Physical Society's Exhibition of Scientific Instruments and Apparatus.—Mon., 18 Jan., to Fri., 22 Jan., 1960, at the Royal Horticultural Society's Old and New Halls, Vincent Square and Greycoat Street, London, SW1. Organised by the Physical Society, 1 Lowther Gardens, Prince Consort Road, London, SW7. Tel. KENsington 0048.

Hotel and Catering Exhibition, International.—Tues., 19 Jan., to Thurs., 28 Jan., 1960, at Olympia, London, W14. Organised by the Hotel and Catering Exhibition (London) Ltd., 623 Grand Buildings, Trafalgar Square, London, WC2. Tel. WHItehall 1371.

***Pilot Plants in Metallurgical Research and Development, Symposium.**—Early February, 1960, at Jamshedpur, India. Organised by the National Metallurgical Laboratory, Jamshedpur 7, India.

Cleaning and Maintenance and Floor Trades Exhibition and Convention, First.—Mon., 1 Feb., to Fri., 5 Feb., 1960, at Royal Horticultural Society's old hall, Vincent Square, London, SW1. Organised by Contemporary Exhibitions Ltd., 40 Gerrard Street, London, W1. Tel. GERrard 4951.

Amusement Trades Exhibition, 16th.—Tues., 2 Feb., to Thurs., 4 Feb., 1960, at the Royal Horticultural Society's New Hall, Greycoat Street, London, SW1. Organised by Amusement Trades Exhibition Ltd., 19 Charing Cross Road, London, WC2. Tel. WHItehall 2524.

Stationery Trades Exhibition, Sixth.—Mon., 8 Feb., to Fri., 12 Feb., 1960, at Alexandra Palace, London, N22. Organised by the Stationers' Association of Great Britain Ltd., 6 Wimpole Street, London, W1. Tel. LANgham 9256.

***Agricultural Machinery and Equipment Exhibition.**—Sun., 14 Feb., to Sun., 21 Feb., 1960, at Brussels. Organised by the Société de Mécanique et d'Industrie Agricole, 29 Rue de Spa, Brussels 4.

Industrial and Commercial Refrigeration Exhibition, First.—Mon., 15 Feb., to Wed., 17 Feb., 1960, at the Old Hall of the Royal Horticultural Society, Vincent Square, London, SW1. Sponsored by *World Refrigeration*. Organiser: Mr. Patrick Smyth, 1 Crane Court, Fleet Street, London, EC4.

Automatic Vending Exhibition and Convention, Second International.—Mon., 15 Feb., to Thurs., 18 Feb., 1960, at the Royal Horticultural Society's new hall, Greycoat Street, London, SW1. Organised by Contemporary Exhibitions Ltd., 40 Gerrard Street, London, W1. Tel. GERrard 4951.

BRITISH TOY FAIR

British Toy Fair.—Mon., 15 Feb., to Fri., 19 Feb., 1960, at Brighton. Organised by the British Toy Manufacturers' Association, 93-94 Hatton Garden, London, EC1. Tel. CHAncery 9158.

Scottish Dairy Show.—Tues., 16 Feb., to Fri., 19 Feb., 1960, at the Kelvin Hall, Glasgow. Organised by the Glasgow Agricultural Society, 51 Moss Street, Paisley, Renfrewshire.

Display Market Week, Third.—Mon., 22 Feb., to Thurs., 25 Feb., 1960, at the Russell Hotel, Russell Square, London, WC1. Organised by the National Display Equipment Association, 2 Caxton Street, London, SW1. Tel. ABBey 4813.

Engineering Materials and Design Exhibition and Conference, First.—Mon., 22 Feb., to Fri., 26 Feb., 1960, at Earl's Court, London, SW5. Organised by Industrial and Trade Fairs Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Scientific Management, 12th International Congress of the International Committee of (COS).—Mon., 22 Feb., to Fri., 4 Mar., 1960, in Sydney and Melbourne, Australia. Organised by the Australian Institute of Management. Inquiries in the United Kingdom should be addressed to the Regional and Overseas Department, British Institute of Management, 80 Fetter Lane, London, EC4. Tel. HOLborn 3456.

Fire Protection Conference, National.—Thurs., and Fri., 25 and 26 Feb., 1960, at the Connaught Rooms, Great Queen Street, London, WC2. Arranged, with the support of the Home Office and the Ministry of Labour and National Service, by the Fire Offices' Committee Fire Protection Association, 31-45 Gresham Street, London, EC2. Tel. MONarch 7412.

Leipzig Spring Fair.—Sun., 28 Feb., to Tues., 8 Mar., 1960, at Leipzig. Consumer goods and technical and capital equipment. Fair offices: Postschliessfach 329, Leipzig C1, Germany. Agents: Leipzig Fair Agency, 39 St. James's Place, London, SW1. Tel. HYDe Park 3111.

UTRECHT FAIR

***Utrecht International Trade Fair.**—*Consumer Goods:* Mon., 29 Feb., to Sat., 5 Mar., 1960, at Utrecht. *Technical Fair:* Tues., 5 April, to Thurs., 14 April, 1960, at Utrecht. Agent: Mr. W. Friedhoff, Netherlands Chamber of Commerce, 10 Gloucester Place, London, W1. Tel. WELbeck 9971.

***Agricultural Machinery Exhibition, International.**—Tues., 1 Mar., to Sun., 6 Mar., 1960, at Paris. Organised by the Union des Exposants de Machines et d'Outillage Agricoles, 95 Rue Saint, Lazare, Paris 9.

Ideal Home Exhibition.—Tues., 1 Mar., to Sat., 26 Mar., 1960, at Olympia, London, W14. Organised by Associated Newspapers Ltd., 161-163 Queen Victoria Street, London, EC4. Tel. FLEet Street 6000.

***Toy Fair, International.**—Thurs., 3 Mar., to Tues., 8 Mar., 1960, at Nuremberg. Agent: Mr. M. Neven du Mont, 123 Pall Mall, London, SW1. Tel. WHItehall 8211.

***Frankfurt International Spring Fair.**—Sun., 6 Mar., to Thurs., 10 Mar., 1960, at Frankfurt. Agents: Lep Transport Ltd., Sunlight Wharf, Upper Thames Street, London, EC4. Tel. CENtral 5050.

***Motor Show, International.**—Thurs., 10 Mar., to Sun., 20 Mar., 1960, at Geneva. Organised by the Fondation du Salon de l'Automobile, 1 Place du Lac, Geneva, Switzerland.

***Lyons International Trade Fair.**—Sat., 12 Mar., to Mon., 21 Mar., 1960, at Lyons. Agents: Robert Brandon and Partners, Ltd., 47 Albemarle Street, London, W1. Tel. HYDe Park 0901.

***Vienna International Spring Trade Fair.**—Sun., 13 Mar., to Sun., 20 Mar., 1960, at Vienna. Apply to the British-Austrian Chamber of Commerce, 29 Dorset Square, London, NW1. Tel. PADdington 7646.

***Agricultural and Animal Farming Fair, International.**—Sun., 13 Mar., to Mon., 21 Mar., 1960, at Verona. Apply to the secretary-general, International Agricultural Fair, Palazzo del Pallone, Verona.

Oil and Colour Chemists' Technical Exhibition, 12th.—Tues., 15 Mar., to Thurs., 17 Mar., 1960, at the Royal Horticultural Society's New Hall, Greycoat Street, London, SW1. Apply to the Oil and Colour Chemists' Association, Wax Chandlers' Hall, Gresham Street, London, EC2. Tel. MONarch 1439.

***Non-Destructive Testing, Third International Conference on.**—Tues., 15 Mar., to Mon., 21 Mar., 1960, at Tokyo and Osaka, Japan. Apply to the British National Committee for Non-Destructive Testing, 1 Birdcage Walk, St. James's Park, London, SW1. Tel. WHItehall 7476.

Polymeric Progress, Conference on.—Wed. and Thurs., 30 and 31 Mar., 1960, at William Beveridge Hall, The University, London, WC1. Organised by the Plastics Institute, 6 Mandeville Place, London, W1. Tel. WELbeck 5439.

Bahrain Agricultural Show and Trade Fair.—Thurs., 31 Mar., to Thurs., 7 April, 1960, at Manama, Bahrain. Apply to the Department of Public Relations and Broadcasting, Manama, Bahrain, Persian Gulf.

Manned Space Stations, Symposium on.—In April, 1960, at the Ambassador Hotel, Los Angeles, Calif., USA. Organised by the Institute of Aeronautical Sciences, 2 East 64th Street, New York 21.

***Nuclear Congress:** Comprising the **Sixth Nuclear Engineering and Science Conference**, the **Eighth Atomic Energy in Industry Conference** and the **Sixth International Atomic Exposition.**—Mon., 4 April, to Thurs., 7 April, 1960, at the Coliseum Exhibition Building, New York. Congress offices: 33 West 39th Street, New York, USA.

Electrical Engineers Exhibition, Ninth.—Tues., 5 April, to Sat., 9 April, 1960, at Earl's Court, London, SW5. Sponsored by the Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London, WC1. (Tel. LANgham 5927): and organised by Electrical Engineers (ASEE) Exhibition Ltd., 6 Museum House, 25 Museum Street, London, WC1. Tel. MUSeum 3450.

MINERAL PROCESSING

***Mineral Processing Exhibition.**—Wed., 6 April, to Sat., 9 April, 1960, at Church House, Great Smith Street, London, SW1. Sponsored by the British Chemical Plant Manufacturers Association, 14 Suffolk Street, London, SW1 (Tel. WHItehall 0766); and the Institution of Mining and Metallurgy, 44 Portland Place, London, W1 (Tel. LANgham 3802). Organised by Industrial Exhibitions (Services) Ltd., 9 Argyll Street, London, W1. Tel. GERrard 1622.

Mineral Processing Congress, International.—Wed., 6 April, to Sat., 9 April, 1960, at the Church House, Westminster, London, SW1. Organised by the Institution of Mining and Metallurgy, 44 Portland Place, London, W1. Tel. LANgham 3802.

Osaka International Trade Fair, Fourth.—Sat., 9 April, to Tues., 26 April, 1960, in Osaka. Offices: Honmachibashi Hiagashi-ku, Osaka, Japan.

Ship Trials and Service Performance Analysis, Symposium.—Mon., 11 April, to Wed., 13 April, 1960, in Newcastle upon Tyne. Organised, in cooperation with the Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2 (Tel. Central 5181), by the North East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle upon Tyne 1. Tel. Newcastle 20289.

***Milan International Samples Fair.**—Tues., 12 April, to Wed., 27 April, 1960, at Milan. Agent: Dr. V. Schiazzano, 31 Old Burlington Street, London, W1. Tel. REGent 2411.

Scotland's Food Exhibition.—Tues., 19 April, to Sat., 30 April, 1960, at the Kelvin Hall, Glasgow. Organised by Trades Markets and Exhibitions Ltd., City Hall, Deansgate, Manchester 3. Tel. Deansgate 6363.

***Packaging Machines, Confectionery Machines and Packaging Materials, Second International Exhibition (INTERPACK).**—Wed., 20 April, to Wed., 27 April, 1960, at Dusseldorf. Apply to the Packaging Centre, 50 Poland Street, London, W1. (Tel. REGent 7781); or to John E. Buck and Co., Ltd., 47 Brewer Street, London, W1. Tel. GERrard 7576.

ASTE Tool Show.—Thurs., 21 April, to Thurs., 28 April, 1960, at the Artillery Armory, Detroit. Organised by the American Society of Tool Engineers, 10700 Puritan Avenue, Detroit 38, Mich., USA.

***Swiss Industries Fair.**—Sat., 23 April, to Wed., 27 April, 1960, at Basle. Apply to the Commercial Attaché, Swiss Embassy, 18 Montagu Place, Bryanston Square, London, W1. Tel. PADdington 0701.

***Lille International Trade Fair.**—Sat., 23 April, to Sun., 8 May, 1960, at Lille. Agents: Weigel, Leygonie and Co., Ltd., 31-32 King Street, London, WC2. Tel. TEMple Bar 4825.

***German Industries Fair.**—Sun., 24 April, to Tues., 3 May, 1960, at Hanover. Agents: Schenkers Ltd., Royal London House, 13 Finsbury Square, London, EC3. Tel. METropolitan 9711.

Compressed Air and Hydraulics Exhibition, International.—Mon., 25 April, to Fri., 29 April, 1960, at Olympia, London, W14. Organised by *Fluid Power, Incorporating Compressed Air and Hydraulics*, St. Richard's House, Eversholt Street, London, NW1. Tel. EUSton 7293.

Production Exhibition, Fourth (International Exhibition of Progress in Industrial Technique).—Mon., 25 April, to Sat., 30 April, 1960, at Olympia, London, W14. Exhibition offices: 11 Manchester Square, London, W1. Tel. HUNter 1951.

Office Management, International Conference.—In May, 1960, at Montreal, Canada. Organised by the National Office Management Association. Apply to the Field Service Division, NOMA, 1931 Old York Road, Willow Grove, Penn., USA.

Distillation, International Symposium on.—In spring of 1960, in England. Organised jointly by the Chemical Engineering Group, 14 Belgrave Square, London, SW1 (Tel. BELgravia 3647), and the Institution of Chemical Engineers, 16 Belgrave Square, London, SW1. Tel. BELgravia 3647.

Mechanical Handling Exhibition and Materials Handling Convention.—Tues., 3 May, to Fri., 13 May, 1960, at Earl's Court, London, SW5. Organised by *Mechanical Handling*, Associated Iliffe Press, Dorset House, Stamford Street, London, SE1. Tel. WATerloo 3333.

Automobile Technical Congress, Eighth International.—Mon., 9 May, to Fri., 13 May, 1960, at The Hague and Scheveningen, Netherlands. This is the congress of the Fédération Internationale des Sociétés d'Ingénieurs des Techniques de l'Automobile (FISITA). Organised by the Koninklijk Instituut van Ingenieurs. Congress offices: 14 Burgemeester de Monchyplein, The Hague, Netherlands.

Institution of Naval Architects, Centenary Meeting.—Mon., 16 May, to Fri., 20 May, 1960, in London. Institution offices: 10 Upper Belgrave Street, London, SW1. Tel. SLOane 4622.

Sheet Metal Forming, Especially Methods of Testing, Colloquium.—Mon., 23 May, to Wed., 25 May, 1960, in Paris. Organised jointly by Société Française de Métallurgie, 25 Rue de Clichy, Paris 9e, and the International Deep Drawing Research Group (IDDRG). Particulars obtainable from the British Deep Drawing Research Group, John Adam House, Adelphi, London, WC2. Tel. TRAfalgar 6171.

Instruments, Electronics and Automation, International Exhibition.—Mon., 23 May, to Sat., 28 May, 1960, at Olympia, London, W14. Organised by Industrial Exhibitions Ltd., 9 Argyll Street, London, W1. Tel. GERrard 1622.

World Power Conference, Sectional Meeting.—Sun., 5 June, to Thurs., 9 June, 1960, in Madrid. Apply to the secretary, British National Committee, World Power Conference, 201-202 Grand Buildings, Trafalgar Square, London, WC2. Tel. WHItehall 3966.

***British Exhibition and Trade Fair.**—Fri., 10 June, to Sun., 26 June, 1960, at the Coliseum Exhibition Building, New York. Organised by British Overseas Fairs Ltd., 21 Tothill Street, London, SW1. Tel. WHItehall 6711.

BUILDING EXHIBITION

Building and Public Works Exhibition.—Sun., 12 June, to Sat., 25 June, 1960, at Durham County Show Ground, Lambton Castle, Chester-le-Street. Sponsored by the Northern Counties Regional Federation of Building Trades Employers, 15 Norfolk Street, Sunderland. Tel. Sunderland 5288.

Large Electric Systems, International Conference on.—Wed., 15 June, to Sat., 25 June, 1960, at the Foundation Berthelot, 28 Rue Saint Dominique, Paris. Organised by the Conférence Internationale des Grands Reseaux Électriques (CIGRÉ), 112 Boulevard Housmann, Paris. Apply to the British National Committee, Thorncroft Manor, Dorking Road, Leatherhead, Surrey. Tel. Leatherhead 3423.

Machine Tool Trades Exhibition, International.—Fri., 24 June, to Fri., 8 July, 1960, in London. Organised by the Machine Tool Trades Association, Brettenham House, Lancaster Place, London, WC2. Tel. TEMple Bar 3606.

Royal Society's Tercentenary Celebrations.—Mon., 18 July, to Tues., 26 July, 1960, in London. Offices of the Society: Burlington House, Piccadilly, London, W1. Tel. REGent 3335.

***Medical Electronics, International Scientific Exhibition and Third International Conference.**—Thurs., 21 July, to Wed., 27 July, 1960, at Olympia, London, W14. Sponsored in association with the International Federation for Medical Electronics by the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. Tel. COVent Garden 1871. Exhibition organised by Industrial Exhibitions Ltd., 9 Argyll Street, London, W1. Tel. GERrard 1622. (Additional information.)

Operational Research Societies, International Federation of: Second International Conference.—Mon., 5 Sept., to Sat., 10 Sept., 1960, at Aix en Provence. Apply to the Operational Research Society, 64 Cannon Street, London, EC4. Tel. CITy 1800.

***Railway Electrification Conference and Exhibition.**—In October, 1960, at Battersea, London, SW8. Organised by the British Transport Commission, 222 Marylebone Road, London, NW1. Tel. AMBassador 7711.

***" Macroplastic " International Fair (Plastics).**—Mon., 10 Oct., to Wed., 26 Oct., 1960, at Utrecht, Holland. Apply to the Fair secretariat: N.V.'t Raedthuys, 5 Tesselschadestraat, Amsterdam-W., Holland.

***Plastics Processing Technology, International Congress.**—Mon., 17 Oct., to Wed., 19 Oct., 1960, at the Royal Institute for the Tropics, Amsterdam. Apply to the Congress secretariat: N.V.'t Raedthuys, 5 Tesselschadestraat, Amsterdam-W., Holland.

***Measuring Instruments, International Congress and Exhibition (INTERKAMA).**—Wed., 19 Oct., to Wed., 26 Oct., 1960, at Dusseldorf. Agents: John E. Buck and Co., Ltd., 47 Brewer Street, London, W1. Tel. GERrard 7576.

***Commonwealth Mining and Metallurgical Congress, Seventh.**—During April and May, 1961, in South Africa. Apply to the Congress Manager, PO Box 809, Johannesburg.

Snow Loads and Roof Design

A detailed study of snow loading on roofs is being made in Canada. It is believed that the Canadian National Building Code is oversafe in the loads that it indicates, for the figures given in the Code are based on ground snow depths; superficial observation showed that roof snow is often appreciably less than that on the ground and this has been borne out by measurement.

A pilot survey was begun in the winter of 1956-57 and the full survey was started in the following year. Measurements are being made by more than 50 observers in different parts of Canada and on a great variety of roofs, including those of hangars and other similar large buildings. Simultaneously records are being kept of wind, temperature, sunshine and rainfall because a prime aim of the survey will be to relate snow accumulations on roofs to those on the ground, and to study the factors that produce the difference. From this data it is hoped to compile case histories that will help designers to determine the snow load in any given set of circumstances.

Radioactivity at Water and Sewage Works

A two-day course on problems of radioactivity at water and sewage works is to be held at the Manchester College of Science and Technology on 14 and 15 January, 1960.

There will be seven lectures during the two days and, in addition, two films will be shown. The first day will provide an introduction to radiological science as it relates to public health engineering problems, with lectures on radioactivity, radiation effects and radiation measurement. On the second day the lectures will deal more specifically with the problems of radioactivity which arise in the laboratories and plant at water and sewage works and with the discharge of radioactivity to natural waters. The lecturers to the course, all of whom are actively engaged on work in this field, are drawn from the University of Manchester, the Christie Hospital and Holt Radium Institute, the United Kingdom Atomic Energy Authority, the Manchester Corporation Waterworks, and the Water Pollution Research Laboratory of the Department of Scientific and Industrial Research.

The fee for the course if £5 5*s* (£1 1*s* for associates of the college). Accommodation in a university hall of residence can be arranged. Full details are available from the Registrar, the Manchester College of Science and Technology, Manchester 1.

From the Hague to Moscow Suburbs

The Netherlands Railways are to introduce a direct rail connection from the Hook of Holland to Moscow, beginning next May.

From Moscow it is announced that the underground railway has been increased from a total length of 81 miles to 135 miles.

Plastic Properties of Rolled Sections

A new handbook entitled *The Plastic Properties of Rolled Sections* has been published by the British Welding Research Association. It gives in tabulated form the plastic moduli, with and without load, of British Standard rolled steel joists, broad flange beams, universal beam sections, channel sections and angles (both equal and unequal legs). The booklet also contains algebraic expressions for the properties quoted, with derivations.

Advice on the content and form of the booklet was given by the Load Carrying Capacity of Frame Structures committee of the BWRA; and information provided by the Bethlehem Steel Company, USA, the South Durham Steel and Iron Company, and Dorman Long and Company, is also included. Compilation of the handbook was the work of Dr. M. R. Horne as part of the investigation of the plastic theory of structures undertaken at the Engineering Department, Cambridge University. It was announced last week that Dr. Horne has been appointed to the Chair of Civil Engineering at Manchester University.

Copies of the handbook are obtainable from the Publications Department, BWRA, Abington Hall, Cambridge (price 8*s* 6*d*).

Engineering Design in Timber

A weekend residential course on timber engineering, sponsored by the Timber Development Association, is to be held at Westham House Residential College, Barford, Warwick, in January, 1960. The course will assemble during the evening of Friday, 15 January and end at lunch time on Sunday, 17 January.

Lectures, discussions and study visits will cover the following: the scope of timber engineering; modern adhesives and glulam techniques; nailed and connectored joints; laminated and plywood construction; shell roof construction; and, finally, bye-laws and specifications. The fee for the course is £5 5*s*, inclusive of meals and accommodation. Further details can be obtained from the TDA Midlands Regional Office, Chamber of Commerce Buildings, 94 New Street, Birmingham 2.

A brief pictorial review of outstanding timber structures is contained in a booklet *Design in Timber*. As well as illustrations of buildings, the booklet describes the facilities available through the Association. Copies can be obtained, free of charge, from the TDA, 21 College Hill, London, EC4.

Wind Erosion Control Measures

Wind erosion of the soil has been a problem ever since man depleted or destroyed the natural vegetative cover, either wilfully or by improper cultivation. Many of the ways available for reducing such erosion are mechanical and were discussed in a paper entitled "Soil Erosion by Wind and Measures for Its Control" given to a meeting of the Institute of British Agricultural Engineers on 10 November. The paper was prepared by the Agricultural Engineering Branch of the Food and Agricultural Organisation of the United Nations.

The four methods available for controlling the erosion are:

(1) roughen the surface of the ground to slow down the wind and trap drifting soil;

(2) produce or bring to the surface from below clods large enough that cannot be moved by wind;

(3) establish barriers and trap strips at intervals across the field to reduce wind velocity and avalanching; and

(4) protect the soil surface with vegetation or vegetative residue.

The application of these four principles to the differing circumstances that might be found over the world, and descriptions of the equipment required, are discussed at length in the paper.

High Buildings in London

An exhibition of photographs, drawings and models of high buildings in London has been arranged by the London County Council. The exhibition, which is being held at County Hall, was opened on 25 November and is remaining open until 19 December. Buildings that have been completed recently, as well as some that are in the course of erection and others that are in the early stages of planning, are dealt with in the exhibition. Opening hours are 9 a.m. until 6 p.m. on weekdays and 9 a.m. to 12 p.m. on Saturdays.

Murrayfield's Electric Blanket

The Scottish international rugby ground at Murrayfield has had heating cables laid just below the turf to prevent the surface from freezing. This will allow the ground to keep its spring when conditions, though playable, would be hard and dangerous. The maximum electrical input is 1,126 kW, available in three equal steps according to requirements.

Nearly 40 miles of Pirelli-General cable is used in the heating mat which was laid using a combination of the David Brown Albion steerage hoe and ripper/mole drainer fitted with a special arrangement for feeding the cable below the turf.

Another similar approach that might well be worth considering by football clubs is the use of electrical-osmosis for drying out particularly wet patches that have developed during play in bad conditions.

Linings for Concrete Shuttering

The illustration (below) shows two concrete posts. That on the right was made in an unlined wooden box—admittedly a poor one—and shows the many surface defects typical of concrete made in much-used wooden formwork. The post on the left was made in a box lined with a polyethylene film made by Bakelite Limited; it has a surface that is both uniformly dense and unstained. Because there can have been little loss of moisture during curing the concrete is probably harder and more resistant to wear.

Concrete posts made in an unlined wooden form and in a box lined with polyethylene.

Artificial "sky" aids Building Research

The Australian Commonwealth Building Research Station at North Ryde, New South Wales, is using a dome, so equipped with fluorescent lighting that it provides artificial skylight for the study of lighting in buildings.

Models of classrooms, factories and office buildings are placed beneath the artificial "sky" to find out how much daylight enters. Inside the models, photocells are used to check the light distribution. A number of full-scale buildings have been similarly examined to "calibrate" the apparatus.

Choosing an Economy Car Statistically

The battle for supremacy in the economy car market has led to the introduction of an unusually large range of models. This makes the problem of selection a difficult one. Good use can be made of the various statistical data available to eliminate much of the complexity of this problem.

A number of new economy cars have been introduced in the past few months. Each of them is excellent in its own way but their merits tend to lie in different directions, making it difficult to draw comparisons. Rather than be swayed by high pressure sales campaigns and reputations that are so often exaggerated, it is sometimes worthwhile making use of statistical data to put the business of assessment on a factual basis.

Ford Anglia

Triumph Herald

Austin Seven

Compromise is perhaps the key to the design of economy cars—compromise of a dozen or so conflicting requirements, such as comfort, acceleration and low fuel consumption. But of course opinions differ as to the relative importance of the various factors of compromise—the tall man needs leg room, the family man wants rear seat space, and so on.

Although many of the factors involved are entirely matters of taste, quite a number of them can be measured and compared numerically. For instance, the manoeuvrability of a car is almost entirely dependent upon the overall length and the turning circle. These can easily be measured and factual comparisons of the manoeuvring qualities made.

In practice, this is best done by making a figure of merit out of the product of the two measurements or, better still, by taking the reciprocal of the product and multiplying it by 1,000 in order to get a simple figure which is directly proportional to manoeuvrability. By this means the figure of merit becomes

$$\frac{1}{L \times TC} \times 1{,}000$$

where L equals overall length and T C equals the mean turning circle (average of left hand and right hand turning circles).

Such a figure gives a good indication of the ease (or otherwise) with which a car could be parked in a tight space. It is much more reliable than the figure for the overall length in this respect; in fact comparisons made in this way often show that the longer of two cars can be parked more easily because it has a smaller turning circle. For example, the overall length of the Volkswagen standard saloon is 13 ft 4 in. which is 2 in less than the Hillman Minx. However, the mean turning circle of the Volkswagen is 36 ft compared with 34 ft for the Hillman, so that the figure of merit of the latter (225) is appreciably better than the former (208), in spite of its greater length. Another example of a car which has surprising manoeuvrability is the Jaguar Mk. IX saloon which is over 16 ft long but has a turning circle of only 36 ft.

Acceleration, top speed, seat widths, miles per gallon and pounds per ton are other measurable quantities. These can be given weightings, according to personal taste and then compared analytically in order to find the best all round car.

The chart given below has no weightings and so can only be of use to someone who regards each item to be of equal importance. It may well be that few people will consider each factor to be equally important, but it only remains for them to add their preference weightings and make the necessary calculations. For instance a buyer who puts miles per gallon and "parkability" at the top of his list, but cares very little for rear seat space (many sales engineers may have these requirements) could put loading factors of two, say, on the former items and a small fraction on the latter. This would entirely change the relative ratings of the cars reviewed.

In the chart below one car, the NSU Prince, was arbitrarily chosen as a standard (it comes half way down the ratings list) and all other cars related to it. This is a simple and quite reasonable way of comparing and it does not much matter which car is chosen. The car which comes out top of this table is the BMC Baby, as might be expected; but it must be emphasised that no weightings have been given to the various factors, and if they had the result might have been quite different.

Perhaps even more important than the lack of weightings from this chart is the fact that parameters such as road holding, appearance and finish have not been in any way accounted for since figures for these cannot be obtained. If these factors could be taken into account then the comparative elegance of the Ford Anglia or the Triumph Herald together with other features of taste, might well put one of them at the top of the table.

A good many of the currently available cars have been listed but there are of course some omissions, due to the limitations of space. The chart is not intended to be exhaustive, either in the cars listed or the parameters chosen, it is rather intended as a guide to putting assessment of small motor cars on a more logical and systematic basis.

The majority of figures in this chart have been taken from *The Autocar* road tests. Other figures were taken from a chart drawn up by Richard Ansdale.

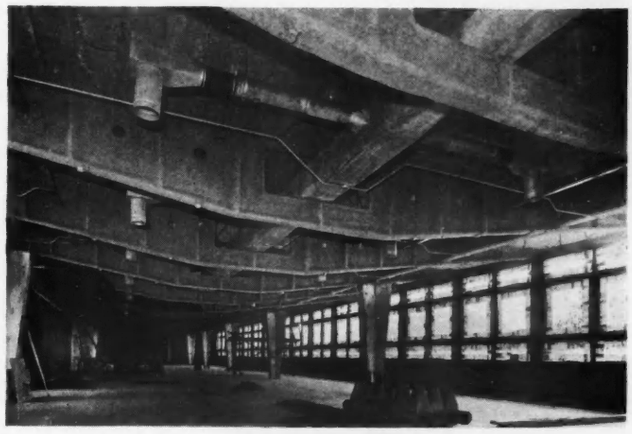
Economy Car Evaluation Chart

—	Austin A40 (948 c.c.)	Auto Union 1000 (980 c.c.)	Fiat 500 (479 c.c.)	Fiat 600 (633 c.c.)	Fiat 1100 (1,089 c.c.)	Ford Anglia (996 c.c.)	Ford Popular (1,172 c.c.)	Morris Mini-Minor (848 c.c.)	Morris Minor 1000 (948 c.c.)	NSU Prince (583 c.c.)	Renault Dauphine (845 c.c.)	Renault Dauphine Gordini (845 c.c.)	Triumph Herald saloon (948 c.c.)
Overall length (ft)	12·0 (0·86)	13·9 (0·74)	9·7 (1·06)	10·5 (0·98)	12·8 (0·81)	12·8 (0·81)	12·5 (0·83)	10·0 (1·03)	12·3 (0·84)	10·3 (1·00)	13·0 (0·79)	13·0 (0·79)	12·8 (0·81)
Miles per gallon (overall)	38 (0·86)	26·4 (0·60)	53·2 (1·13)	38·4 (0·87)	34·7 (0·79)	36·1 (0·82	33·9 (0·77)	40·1 (0·91)	36·3 (0·82)	44·0 (1·00)	40·9 (0·93)	42·1 (0·96)	33·2 (0·73)
Miles per hour (max.)	72 (1·15)	80 (1·28)	57 (0·91)	57·1 (0·91)	75 (1·20)	77 (1·25)	71 (1·13)	73 (1·17)	72 (1·15)	63 (1·00)	65 (1·03)	72 (1·14)	70·1 (1·12)
Steepest gradient in top gear	1: 12·5 (1·04)	1: 13·5 (0·96)	1: 23·6 (0·56)	1: 18·7 (0·69)	1: 13·9 (0·94)	1: 9·9 (1·32)	1: 14·4 (0·90)	1: 12·3 (1·05)	1: 12·8 (1·02)	1: 13 (1·00)	1: 18 (0·72)	1: 16·6 (0·79)	1: 11·4 (1·14)
0-50 m.p.h. acceleration (secs)	21·4 (1·20)	15·3 (1·68)	42·0 (0·62)	43·0 (0·60)	17·4 (1·48)	17·8 (1·45)	23·8 (1·08)	16·9 (1·55)	18·7 (1·38)	25·8 (1·00)	25·1 (1·03)	19·0 (1·36)	19·3 (1·34)
Mean turning circle (ft)	36·9 (0·73)	36·8 (0·73)	25·2 (1·07)	27·7 (0·97)	32·4 (0·84)	32·3 (0·84)	32·3 (0·84)	31·9 (0·85)	32·4 (0·83)	27·0 (1·00)	30·6 (0·88)	31·7 (0·85)	25·7 (1·05)
Front seat width (in)	44 (1·16)	50 (1·31)	43 (1·13)	50 (1·32)	50 (1·32)	45 (1·18)	50 (1·32)	46 (1·21)	46 (1·22)	38 (1·00)	47 (1·24)	47 (1·24)	46 (1·21)
Rear seat width (in)	45 (0·89)	50 (0·99)	41 (0·87)	51 (1·02)	50 (0·99)	44 (0·87)	47 (0·93)	45 (0·89)	47 (0·93)	50·5 (1·00)	50 (0·99)	50 (0·99)	45 (0·89)
Price in Great Britain, including purchase tax (£)	639 (0·95)	1,241 (0·49)	525 (1·13)	613 (0·99)	820 (0·74)	589 (1·02)	494 (1·22)	497 (1·23)	590 (1·02)	605 (1·00)	716 (0·85)	848 (0·71)	702 (0·86)
Total marks	8·84	8·79	8·48	8·35	9·11	9·56	9·02	9·89	9·21	9·00	8·46	8·83	9·15
Percentage figure	98·1	97·6	94·2	92·7	102·1	106·1	100·1	109·5	104·5	100·0	93·9	98·1	103·2

Engineering in Big Buildings

Many factors have contributed to the growth of multi-storey buildings. There is the need to economise in ground area, frequently linked with a compulsion to build in an established commercial area; and the costs of erection and fitting out can be cut—men, materials and machines being concentrated within a small area.

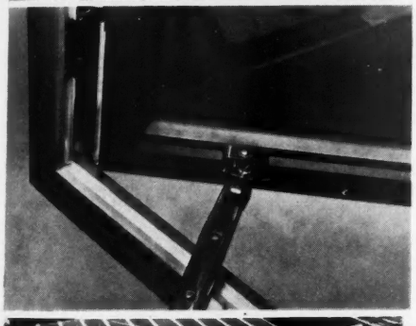
On this and the next page are illustrated materials and services going into modern buildings. Many of the illustrations are of products that have been displayed at the London Building Exhibition, now open at Olympia. There follow three special articles. The first discusses, especially from the architect's point of view, the changing relationships between the architect and the consulting engineer. New techniques, particularly site mechanisation, are discussed in the other two articles.



(Above) Fire endurance of two hours is given by a ¾ in coating of Silbestos; heat and sound insulation are also improved. Sprayed Insulations Ltd., London, E14.

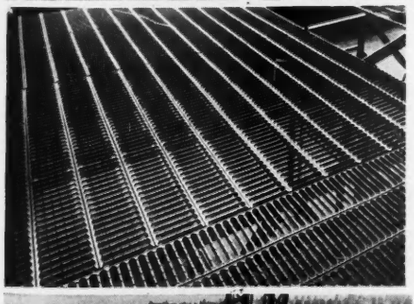
(Left) The Welford door comprises two counterbalanced panels hinged at the middle. It may be either manually or power operated. Westland Engineers Ltd., Yeovil.

(Right) Thermalite blocks used in the construction of a multi-storey office block. The material is lightweight but sufficiently strong to be load bearing; it has high thermal insulation properties. John Laing and Son Ltd., London, NW7.



(Left) Advantage is taken of maintenance-free plastics for this metal-cored window frame, which is available in a range of different colours. Crittall Manufacturing Co. Ltd., London, WC1.

(Right) The conference and concert hall in the Portsmouth Guildhall, seating 2,000 people. Cornice lighting gives 30 lumens per sq. ft at floor level; the lamp wattage is graded from front to back. General Electric Co. Ltd., Kingsway, London, WC2.

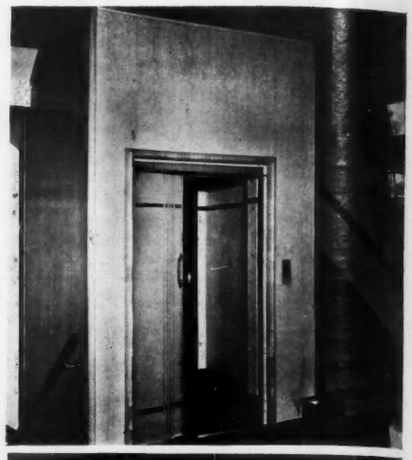


(Left) Industrial flooring grid made from an open steel plank. Available in two sizes and a standard width, it is quickly assembled with fixing plates, nuts, and bolts. Dexion Ltd., London.

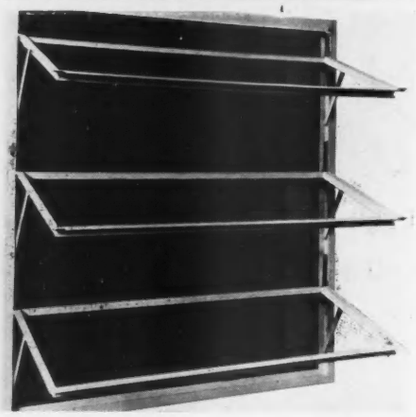
(Right) Stainless steel lift door in the new chemical laboratory of Samuel Fox at Stocksbridge. Panels of stainless steel (18 per cent chromium, 8 per cent nickel) are used on the outside walls. United Steel Companies Ltd., Sheffield.

(Left) Bison precast concrete units for multi-storey flats. The partition walls are load bearing. Projecting reinforcement is used to tie the stair unit to the flooring. Concrete Ltd., London, WC2.

(Left) Girdaling is a lightweight beam of graded timber sheathed with Douglas Fir plywood. In the Major range, beam depths vary from 8 in to 24 in for spans up to 50 ft. H. Newsum Sons and Co. Ltd., Lincoln.



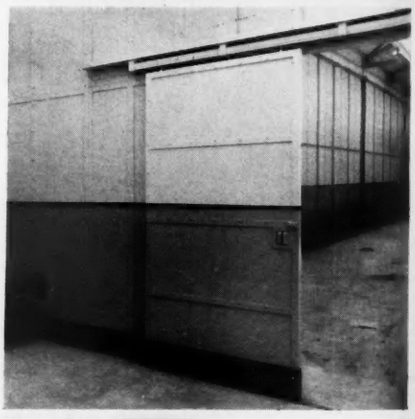
(Right) Warerite-panelled lift shaft. Warerite has an extremely hard plastics laminated facing that is available in many colours and differing patterns. Bakelite Ltd., London.



(Left) A "projected" window for use in tropical climates. A new range being made and available in no less than 27 standard types. Henry Hope and Sons Ltd., Birmingham.

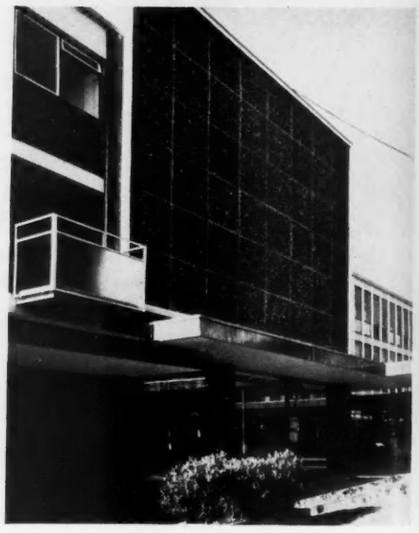
(Right) Cunic partitioning in an office setting, employing different treatments of the front and side walls. Holland & Hannen and Cubitts (Great Britain) Ltd., London, SW1.

(Left) Isora translucent ceiling, as used at a Solartron factory making transducers, where the working space is slightly pressurised to exclude air-borne dirt. The ceiling was slung below existing fluorescent troughs. SFIM (G.B.) Ltd., Slough.



(Right) Typical factory subdivision by partitions and sliding doors all clad with fire-protection panelling of twin steel outer faces bonded to a compressed asbestos core. Durasteel Ltd., Greenford, Middlesex.

(Left) Distribution box for rising mains feeding a multi-storey building. The box contains twelve 60A fuses, which can be picked up to suit a variety of circuits. British Insulated Callender's Cables Ltd., London.



(Right) Exposed aggregate cladding panels on an office block in Stevenage new town. The panels can be supplied to any specified sizes, including modular sizes. John Ellis and Sons Ltd., Leicester.

The Architect has Prime Responsibility

Modern building construction is a corporate undertaking of architects and engineers. A clear division of responsibilities is needed. The engineer must be subordinated to the architect; but without their collaboration the design will not fulfil its purpose.

By E. D. Jefferiss Mathews, O.B.E., F.R.I.B.A., A.R.I.C.S.

For the design and construction of any medium to large building project—and in fact for many smaller ones—there are at least five, and often more, people in a leading capacity who are engineers. There is only one architect. So on sheer weight of numbers it seems that there is more "engineering" in the building industry today than "building"—if by "building" we are thinking in terms of design and the more simple and orthodox materials and methods of construction, such as bricklaying, carpentry and joinery, plastering and painting.

From the point of view of technology this is true. It is misleading from the overall point of view of responsibility for the design and construction of buildings, as distinct from civil engineering projects, and it does not give an accurate picture of the whole process of the building industry. But it shows very clearly the importance of the engineer, and it immediately indicates the corporate nature of building which has been forced on the industry by modern needs and the technical advances made to fulfil those needs.

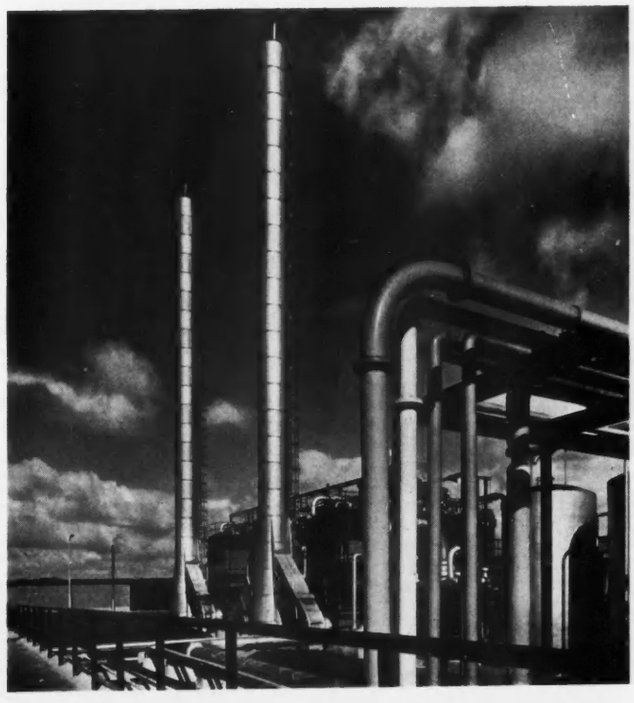
Fifty to a hundred years ago there were only few materials available for building and their characteristics and capabilities were well known and had for long been established. There was little or no equipment of an engineering kind which had to be built into buildings as part of their design. The whole process was comparatively simple and within the operative capacity of two people: the designer, whether architec or engineer, and the builder. It was possible, as in fact was the case, for a single master mind to have overal lcontrol from design to the supervision of erection.

The advantages of this single master are apparent in a single responsibility and therefore a unification of the whole process. But if we look at the picture today we find a complexity which is surprising even to those of us who have been brought up in the industry while it has been developing. If only a few materials, techniques and equipment common today are considered we find that since many of us started our working life, perhaps 25 years ago, we have seen the development of reinforced concrete, the introduction of prestressed and poststressed concrete, the common use of artificial ventilation and air-conditioning as directly affecting the design of the building, the structural use of light alloy metals, the welding of steel and the introduction of plastics and man-made fibres as directly affecting the weather-proofness and finishings of our buildings.

Impact of Complexity

It is obvious that the single master-mind for the creation of a building can no longer cope. Our task now is to find out the best way to develop a corporate arrangement which can as near as possible correspond to the advantages of the single mind. Inevitably, during the rapid development of these past few years, many results have been purely piece-meal—each individual working away in his own sphere regardless of the effect of his contribution on those of others—so that design has often been bad because it has been unrelated to the whole, the best use has not been made of the techniques and materials at our disposal because of the lack of individual knowledge. This has led directly to complicated construction which has prevented the builder from making the best use of the equally rapid developments and improvements available to him in the methods of erection. Gradually we

Continued on next page



(Right) Collaboration between architects and mechanical engineers.

(Lower left) An engineering appreciation of aesthetics from an architect's conception.

(Lower right) Collaboration between architects and structural engineers.

are pulling out of this selfish state of affairs towards a proper corporate understanding but we are not moving fast enough and many architects, engineers, builders and operatives are trying to hang on too long to the old methods, the old approach and the old status of our several individual spheres.

I define the operation of building as the enclosure of space to fulfil a given purpose in such a way that the purpose is economically and efficiently achieved and aesthetically right. These three requirements depend initially for their success on design. The first one—the right economy—also depends on the operating methods of erection. So there is no clear-cut division of responsibility between architect, engineer and builder—all have a corporate responsibility. The difference between the design side (architect and engineer) and the erection side (builder and engineer) is that if the design is at fault, it can prevent the erection being carried out as economically and as efficiently as possible. A great responsibility therefore rests with the designers.

But the point of interest for the engineer is that he alone at present is on both sides. A very big responsibility therefore falls upon him. But not, I think, the biggest share of the responsibilities of all of us. This is a controversial point. My definition of building establishes that the most important aspect is that the design should be right—right for the efficient use of the building, right architecturally, and right for the economical erection of the building. Who is primarily responsible for design—architect or engineer? I am emphatic in saying that it is the architect—not because I am one, but because of facts based on the nature of the training of the architect and engineer, which must of necessity be different.

Sense of Aesthetics

This is not an article to discuss an alleged controversy between architect and engineer—I do not think that a controversy exists—but, to consider the position of the engineer in the "team," it is necessary to express an opinion of his position in order to establish where his responsibility lies.

I see it in this way. The architect takes the problem posed by the building owner for enclosing a space to meet a requirement. He, the architect, is trained to solve that problem. He is trained to solve it three-dimensionally so that the internal arrangement is right—loosely and misleadingly referred to as "planning"—so that internally and externally it is good architecture, human and pleasing, and so that it is economically right for the purpose and conditions imposed. That, broadly and over-simplified, is the first part of the architect's contribution and responsibility—I think it is the biggest and the most important. It is followed by his responsibilities for coordination, leadership and supervision, since every "team," however well integrated, must have a leader.

But at every turn in performing these responsibilities he is faced with problems which are wholly engineering in character—structural form, electrical and mechanical services, the building operation. What does he require from his engineers—all five of them or even more—who must advise him on these matters? To answer this briefly, he requires first that engineers have a sympathetic sense and awareness of aesthetics—in other words a sense of "design." That goes for the structural engineer as much as for the electrical and mechanical engineer—the position and design of a light switch, for example, is important to the success of a building. Secondly, the architect looks to his engineers as real collaborators in his design—too often we find today that the engineer will obey rather than collaborate, so that to meet an architectural whim, which may be nonsense, he will fall over backwards to evolve a piece of structure, or the arrangement of a mechanical installation that, however clever it may be, is as bad a piece of engineering, and consequently uneconomic, as the architect's whim was bad architecture.

Thirdly, we expect equal administrative collaboration. Goodness knows that architects have got a bad name for administration—we are aware of this and trying hard through many ways, including those of post-graduate training, to overcome it—but as a generalisation engineers are no better. As we architects advance in our administrative methods, so we look for equal advance from the engineers.

Public Distrust

So much for engineering on the design side. Now on the erection side. This obviously is inseparable from the builders' part in the industry. In the space of this article it is too big a subject to cover in any detail, but there are perhaps two essentials which summarise the position. The status and integrity of the builder must be raised and probably the engineering element, coming basically from a professional background rather than a commercial one, can help towards this more than others.

The majority of building contracting firms operating today have a high integrity, but collectively the builder is still suspect in the minds of the public. This arises from reasons both false and real—the fact that there are sufficient real reasons for the public's view is sufficient for the builders to work hard among their widely varying members—from the smallest firm to the largest—to eradicate the opinion with which they are now regarded. Until the higher status is reached the best contribution which the builder has to make to the industry cannot be achieved.

One very important point hangs on this question of status. Ideally design should be evolved in the closest collaboration with those who will erect it—in this way both architect and engineer on the design side can, at all stages of evolution of the design, have the advice of the expert who will erect the building, and so both sides of the engineering element, which are not diametrically opposed, can work together. But until the status of the builder is raised to the extent that he will generally be "appointed" at the outset of a project instead of the costly and dicey method of competitive tendering—as the architect and engineering consultants are appointed—this corporate development of the design cannot be adopted.

Of the many things that can be done to improve the present position, one of importance is the introduction of some form of combined technical education—particularly between architects and engineers on the design side, but equally with the builders. Most of our problems arise from our respective present educational methods. Architects lack administrative training. Engineers lack any education in what I have called a design sense or an appreciation of design. The training of builders and operatives has much too great a bias upon the old crafts and trades and not sufficient forward thinking towards new techniques and methods.

In making a plea for combined education I must say at once that I do not seek that all training should be the same, nor should it attempt to produce the "wonder man"—combined architect-engineer-builder—that is impossible. But whether at pre-graduate stage or post-graduate stage—probably the latter—great advantages and improvements in the mutural understanding between architect, engineer and builder could be achieved. This would go a long way to ensure that the best is made of engineering in building.

To Catch Up with the Times

From the vital and all important human problems of engineering in the building industry we should consider also the technical ones. Our industry is not exceptional in the recent rapid advance of technology. After an initial setback some two thousand years ago, for reasons now obscured by time, the history of scientific development has been one of rapid advances followed by slow, almost static, periods. But the pattern has been that each period of advancement has been more rapid than the previous one, and each period of slow development shorter.

It would seem perhaps that there is an ultimate completion to this evolution. I doubt it—certainly it is not within the scope of this article to speculate on it! It is only for us to consider the developments of our industry in comparison with others. We are lamentably behind others.

Architecturally we were terribly pleased with ourselves in the early twenties of this century when we played with functionalism, in a form now rightly considered to be inhuman, with techniques which had existed for a hundred years! Then they were being used genuinely and logically—we were using them artificially. Now, aided and abetted by our clever engineers we have swung to a false romanticism which may be worse. None of this is true architecture—neither historically nor traditionally has architecture been a whim of fashion nor based on false techniques. We have been led astray because technology forged ahead beyond our control and the engineering collaboration and guidance, which we should have had, was missing. So in these past years architecture for the first time has been divorced from its true relationship to techniques and materials. On the one hand we have been putting up trick stuff, on the other just copying our grandfathers.

Learn from Others

Architects have been as responsible for this sad state of affairs as anyone in the industry. I have stressed that on the human side it is our responsibility to lead—we must therefore accept responsibility for the failures on the technical side. But in fairness to ourselves this failure must be shared with the engineers. Unresponsive to the trends of development we may have been—conservative to the extent of reactionary have been the engineers.

Only one example of many is necessary to make my point. As a structural medium, steel—and from steel to light metal alloys—is a first class material. Tension stresses are more economical than compressive ones. The aircraft industry found that out through the circumstances forced upon them by the conditions in which they work. Technically the answers to the proper use of steel, and the use of tension stresses, are known, yet engineering in the building industry has done practically nothing to introduce them nor taken steps necessary to amend codes of practice to enable full use to be made of the economic and practical potentialities.

There are many other examples in which the engineering mind—the scientific rather than the creative mind of the architect—should have moved forward to provide for us the technical developments we could use. Plastics, ironmongery, space heating, ventilation. The motor car industry, as another example, has moved forward far more in these spheres.

If engineering is to play its proper part in the building industry one of its responsibilities must be to be aware of its part in scientific development. The architect's part must be primarily in the solution of the human and social problems—to do this properly we need at our finger tips the most advanced scientific and technical knowledge. We rightly look to the engineering element to provide this. By and large the engineers have failed to do so because either they have failed to seize the opportunity for collaboration, or we have locked them out—but the result is the same, they have obeyed, not collaborated.

Joining together the human element and the technical aspects of engineering in the building industry, I see the picture in this way: Engineering and science have become the principal, practical and economic features of the industry. This leaves the architect to be the rightful basic creator of the human and social solution to the problem of enclosing space for a given purpose. Because of this he must be the leader. But he cannot within normal human limitations accomplish this task without the engineer.

The engineer must be the servant collaborator of the architect to develop the technical knowledge which is available so that the architect can design—as tradition has always been—up to the limits of the materials and techniques of the period in which he works.

Tower Cranes Change Building Designs

Until recently mechanical plant has been conspicuous by its absence from building sites; but the recent trend to taller buildings has increased mechanisation, and some new methods have been evolved.

By J. F. Eden

It is astonishing to realise what little impact mechanical engineering has had on the building site in the last few decades. In the fifteen years since the end of the war, some 3 million houses have been built, but in spite of considerable effort over a decade, and experimentation on a scale unprecedented anywhere (with the possible exception of the USSR), most of these houses have been built with little aid from mechanical plant, other than a small concrete mixer. And yet every house contains about 140 tons of material, often handled three or four times during construction. The root problem in mechanising these traditional processes is that they are never fast enough, and they are spread over too wide an area. It is difficult to justify the employment of mechanical handling plant when materials are used up so slowly. The average rate of consumption of materials when, for example, a single council house is built, is only a few hundredweights a day. The obvious answers to this problem have both been tried. First, by the concentration of traditional processes on a large site of council houses, it has been shown possible, with good organisation, to increase the rate of usage of materials within a small area, so as to justify the use of mobile mechanical handling plant like hoists or cranes. Secondly, many attempts have been made to replace difficult traditional trade processes by others that lend themselves more readily to mechanisation. In most cases, this has led to prefabrication, in an attempt to ease the difficulty on site by diverting the work to the factory. The main difficulty has been to provide continuity of work in order to get competitive costs. Now that the non-traditional housing subsidies have been withdrawn, only a few of the many ingenious alternative systems of construction remain to compete with traditional processes. Those which remain in the field are largely the most flexible, employing methods which can be used to build blocks of flats and schools as well as houses, village-halls or even swimming pools.

Of more recent years, we have started to build upwards in our city centres, a trend necessitated by shortage of ground space. This offers considerably greater scope for mechanisation, for although the weight of material in a given volume of these tall buildings may be little more than in a similar volume of a 2-storey building, the work is concentrated into a smaller area, and the greater cost per unit of building offers rather wider scope for alternative methods. As yet, the proportion of our building effort expended on multi-storey buildings is only about 30 per cent, but surely it must increase, and an effort has to be made to reduce the cost of multi-storey buildings to a figure comparable with that for lower buildings.

Mechanisation has already begun to play a part in this process, as a glance around the London sky-line will show. The Continental tower crane, first introduced into this country in 1950 by the Building Research Station, is most suitable for building the concrete structures of the many multi-storey blocks of repetitively planned offices and flats now under way. These machines are now so prevalent that they are beginning to affect building design. A typical tower crane used for this purpose would be a fully slewing, rail-mounted electric crane supplied from the mains by a trailing cable, with separate motors for hoisting, varying the radius, slewing and travelling. The main characteristic of all types is a tall tower and a very long jib, with a capacity in popular models of about 1 ton at 70 to 100 ft radius. Models produced in Germany shortly after the war had the slewing ring (and all the ballast) at the foot of the tower, so that the tower revolved as the crane slewed (Fig. 1a), but in more recent French and German models the slewing ring is at the top of the tower, and the non-revolving mast is built up of bolted sections. Motor and control gear are not complicated; the hoist motion is normally provided with a two speed gearbox, driven by a slip-ring induction motor. In either gear therefore, the only speed control is that afforded by the starting resistances. Motors for other motions may be squirrel-cage induction motors on the smaller cranes. The crane may be driven by drum-controllers in a cabin high up in the mast, but on recent models the controllers are replaced by low voltage relays operating contactors, actuated by press buttons at the end of a wandering lead. Thus the driver can control the crane from the cabin, from the ground or from the building, according to the needs of the moment.

The main attribute of modern tower crane designs is their versatility in use, and an important requirement is that they should be quick and cheap to erect on the difficult and congested sites which are the rule rather than the exception. The base of the crane carrying the ballast is usually in one piece, which may be mounted on road-wheels and towed to the site, or brought on a low-loader. Many different and ingenious systems have been devised for erecting the superstructure. As shown diagrammatically in Fig. 1(*a*), the mast and jib may be connected together and laid out horizontally, with the mast on top and the jib tip lashed back to the mast. The heel of the mast is hinged to the base of the crane which is loaded with ballast. The derricking rope in its normal reeving is then used to pull mast and jib upright. After the mast heel is bolted in position, the temporary jib lashing is removed, and the derricking rope raises the jib. In Fig. 1(*b*), the tower is first erected to full height in sections which are lifted one at a time by a jury-jib, reeved from an erecting winch which climbs the tower as it grows. The slewing head of the crane, made up of two slewing rings, jib, counter-jib and all working parts, is erected round the square tower near the ground, and the hoist rope, reeved in eight falls to a crosshead at the top of the tower, is used to pull the whole assembly up the tower, to any working height desired.

In the cranes shown in Figs. 1(*c*), 1(*d*), 1(*e*), the tower is also built up vertically in bolted sections, but additions can quickly be made to its height without lowering the jib and slewing head. In Fig. 1(*c*) the slewing superstructure is built near the ground with a short slewing mast inside the first section of the tower. Further tower sections are built in panels round the slewing mast by the crane itself, which is then raised by means of a power operated screw-jack to a new position in which additional panels can be built on to the tower. In the working position, the slewing superstructure of the crane in Fig. 1(*d*) is mounted on top of the tower, but additional tower sections can be added by lifting the superstructure off the head of the tower on a square framework, open on one side, which is mounted round the tower and hoisted up it with a special erection winch. When the slewing superstructure has been sufficiently raised a new tower section can be added through the open side of the lifting framework, the head-gear lowered on top of it and bolted into place. Finally, in the crane shown in Fig. 1(*e*), the hydraulically luffed jib is mounted well behind the slewing centre and axis of the tower, giving such a small minimum radius that the crane itself can place additional sections on top of

Continued on next page

Fig. 1a Mast and jib connected together.

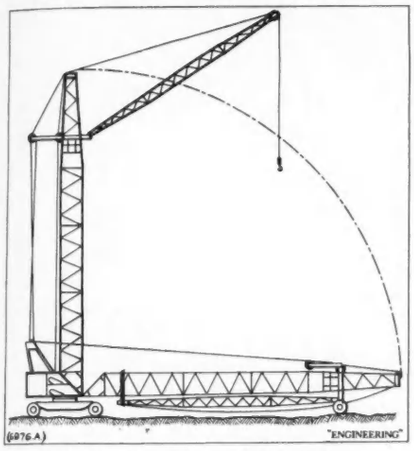


Fig. 1b Tower is erected in sections.

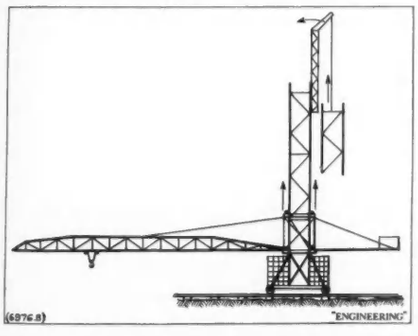


Fig. 1c Slewing superstructure is built near ground.

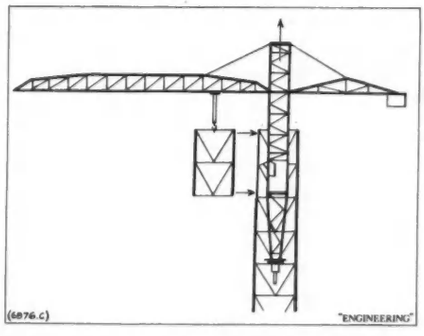
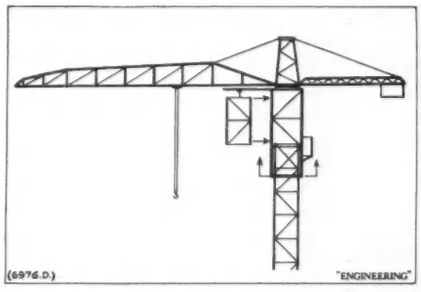


Fig. 1d Slewing superstructure mounted on tower.



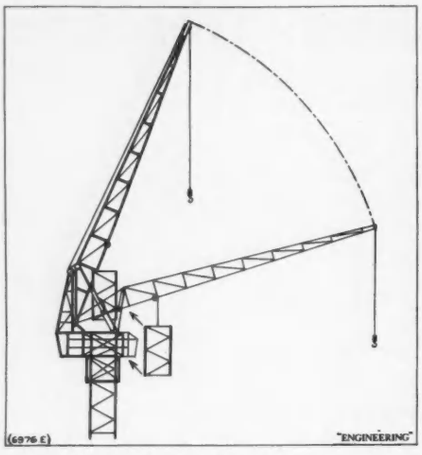


Fig. 1e Crane places additional sections on tower.

the tower. After such additions, the whole of the working parts of the crane, mounted on slewing rings surrounding the tower, are raised up the new section by means of a specially reeved rope and erection winch.

Climbing Cranes

The cranes with segmental towers can be used in a number of different ways. Mounted on rails they can travel freely under load when erected to heights up to about 100 ft. If erected much higher than this, the amount of ballast necessary to make them safe in a storm is usually excessive, and the crane is removed from its base and provided with a fixed anchorage. As fixed cranes, the working height can be greatly increased, the stiffness of the tall slender tower being increased by tying it to the building. There is yet another way in which the smaller of these segmental tower cranes can be used with a short tower. The crane may be mounted on a fixed anchorage in the foundations of the building. In this position it is used to build the first few floors, holes being left for the tower. At a later stage, the whole crane is disconnected from the base and hoisted through the floors with a winch, to be anchored to the building in a higher position. These so-called climbing cranes have become very popular on tall point blocks on congested sites. Being mounted inside the building (often in a lift shaft) they do not occupy valuable ground space required for the storage of material, while the full diameter of the slewing circle can be utilised to cover the building, rather than the radius, as would occur if the crane were erected outside the building. In this way a small crane can be used to build a big building. The installation of a climbing crane, of course, involves checking that both the vertical loads and moments imposed by the crane can safely be taken by the building. With the smaller sizes of crane this is not usually a problem. The use of the tower crane in its various forms has had a noticeable effect in speeding up the construction of tall buildings. The effect is most marked in the case of concrete structures which are repetitive, floor by floor, such as can often be the case in flats and offices, for then shuttering can be handled from floor to floor by the crane in large units, and a rhythmic sequence of formwork, reinforcing and concreting established. It may be noted that the majority of these concrete structures are cast *in situ*, but the use of a crane has a great advantage over earlier methods in that awkward or lengthy processes (such as the manufacture of some perimeter beams, flights of stairs and balconies) can be cast on the ground, where their manufacture does not delay other work, and installed quickly by the crane. Where full advantage can be taken of these attributes, one crane can erect concrete building structures of up to 5,000 sq. ft floor area at the rate of about one floor per week. On the other hand, a similar structure, not designed with the use of a crane in

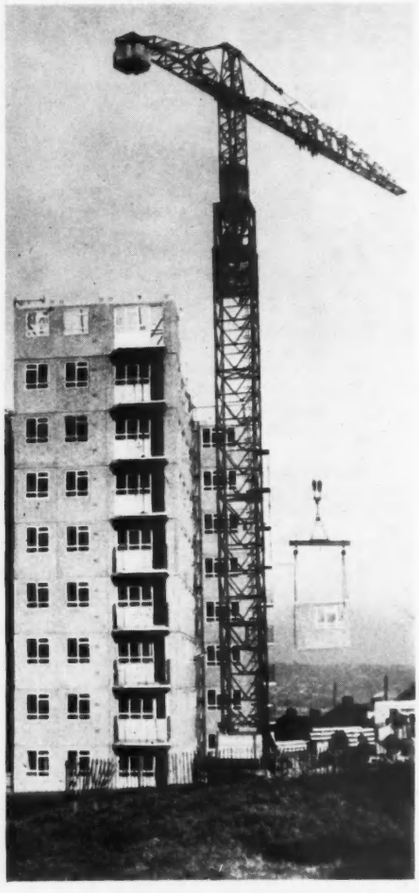


Fig. 2 Multi-storey block of flats with a repeated floor plan.

mind, may take four times as long. It is becoming increasingly important for structural designers and architects to consider "buildability." The use of cranes has brought some other innovations in train. Bricks are now being delivered to many sites in packs of 50, wheeled from the lorry to a hoist and along the scaffold with special barrows, or lifted in multiples by the crane direct from the lorry. All the bricks for the South Bank site (some 16 million) are thus packed. The system, developed by the Building Research Station, is now being extended to the handling of partition blocks, and many other goods are now arriving on site in a manner suitable for unloading by crane.

Developments have also taken place in the field of concrete production. The cement bag has virtually disappeared from the larger building sites in the past few years. Cement is now taken in bulk with a considerable saving in cost. It is blown in a stream of air from a pressure vessel on the lorry through a flexible pipe to a silo on the site. The manual loading of aggregates into the mixer or weigher is also a thing of the past, for all leading makes of concrete-mixer, except the very smallest, can now be supplied with an integral "hand-scraper" for loading aggregates into the hopper. This device is a hand-steered dragline scraper pulled by a winch mounted on the mixer which is driven through an electro-magnetic clutch and operated by a press-button mounted on the handle-bars of the scraper. The combination of cement silo, mixer with integral weigher and hand-scraper forms a very simple and effective unit for concrete production, capable of producing up to 12 cu. yd per hour of concrete with two men. The production of concrete on site is, however, being challenged by off-site production by specialised firms selling ready-mixed concrete. Although in straightforward circumstances there is perhaps still a marginal advantage in cost for site mixing, ready-mixed concrete is rapidly gaining ground and has many advantages. Quality can be controlled more easily than on the site, there is less waste, and the absence of a concrete mixer and its associated piles of ballast frees much needed space on a city site. A further advantage was recently demonstrated in London when 700 cu. yd of ready-mixed concrete were placed in the foundations for a multiple store in a single day. This rate of production is very much higher than could have been achieved had the concrete been mixed on site.

Precast Load Bearing Wall Panels

In contrast to the normal methods of building structures with a reinforced concrete frame, later clad with brickwork or other facing, we may instance two interesting developments along other lines. The first, shown in Fig. 2 on the left, is a method of building multi-storey blocks in which the floor plan is the same at all levels, and represents a development of methods previously used for building silos or other simple vertical-sided structures. Shuttering for all load-bearing walls is built at ground level, about 4 ft high, the inner and outer skin being connected by yokes across the top, and the inner skin supporting a working platform. The whole of this shuttering and platform assembly is made to rise in increments of about 1 in every 4 min by special hydraulic jacks mounted on the yokes at intervals of about 6 ft, which climb up vertical reinforcing bars and are automatically and centrally operated. The whole formwork is therefore made to rise continuously at a predetermined rate, and the concrete for the walls is also placed at the same speed. Work on the load-bearing walls can therefore progress as fast as one storey every 24 hours, but this creates some problems in inserting the floors at a later stage. Because of these difficulties, it may be better to halt the progress of the walls ever 24 hours, and, on alternate days, instal a precast, or composite floor. The development of this method does great credit to the Swedish, German and British engineers who have been concerned in overcoming the difficult technical problems involved, notably those of keeping the building plumb as it grows, and of keeping the window frames and other insertions in position as the formwork moves past them. In another development, the multi-storey building is constructed from wall-size load-bearing concrete panels, made in a factory and erected on the site by a crane. This British development is paralleled by others in Russia (on a very large scale), in Sweden, in France and in America, where similar methods are being explored, but in some cases the panels are made on site.

Taken together, these developments represent trends which cannot be ignored. Both are extremely fast, and involve the more rational and continuous use of engineering plant. In both there has been a logical departure from the normal concrete design in which the loads are carried by a frame and the cladding, or walls, are structurally unnecessary. Whether either system, the *in-situ* method with climbing shuttering, or the precast method with large panels, can develop into a widely used substitute for existing methods, depends on economics and other factors. In the opinion of the author, any new method must be adaptable enough to become an architectural medium, rather than a method of constructing one particular design of building. Furthermore, success will depend on how much the system displaces traditional building processes, for it must be regarded as a real criticism of existing mechanisation in building, that it affects only the structure. After the diggers and concrete mixers have completed their work, after the cranes have lifted their last load, there is still about half the building work to complete. Then come the bricklayers and plasterers, to build the partitions and plaster the walls, also the sub-contractors to instal the services, followed by the painters and the carpenters. All this work is still done by hand, and its mechanisation will require a revolution in methods of which, as yet, there are only the most distant of rumbles.

New Building Techniques

Time and motion study has come to the building industry. This, coupled with increasing use of prefabrication methods and mechanisation of operations on site, is causing far-reaching repercussions both on design of buildings in the United Kingdom and the speed at which they are erected.

By J. L. Robinson

The years since the war have seen the rapid mechanisation of building methods, and the introduction of more mechanical plant and equipment has in turn stimulated interest in improved techniques for carrying out building operations more efficiently and at lower cost. Mechanical aids have eliminated many of the laborious and wasteful methods, and operations on site are being mechanised so that the builder's task becomes increasingly one of assembly rather than on site construction.

Progress along the direction of the use of factory-made units assembled and placed on site with mechanical aids allows speedier building, while the concrete-making process is done in the factory under strictly controlled conditions. This enables the use of higher strengths of concrete, so that the builder is given smaller sections, slender columns and shallower floors, with obvious savings not merely of concrete and other materials but in the transport and erection cost.

With the latest developments in prestressing and precasting considerable economies in the weight of steel used can be made; moreover greater flexibility in design, erection and manufacturing are possible. The technique of prefabrication has provided many excellent light, flexible structures which have made their mark on post-war building. For example, the school building programme in this country largely used prefabricated components and units, and has provided schools of outstanding design at remarkably low cost. It has been estimated that a new school building today is about 20 per cent cheaper than in 1949, and much of this is due to the use of these new techniques.

In house-building, too, there has been some advance in prefabrication, but while the use of certain factory-made units has resulted in speedier and cheaper building—plasterboard inner walls and ceilings, for example—the mass production of houses has not generally speaking shown any considerable saving in cost over more traditional methods and the inflexibility in design is a disadvantage.

The provision of houses continues to be one of the essential services provided by the building industry. With the shortage of land, the increasing population, and the acceleration of the slum clearance programme, emphasis is more and more placed on building upwards, that is to say, avoiding suburban sprawl by building higher, even up to 20 or 30 storeys. In the past the cost has been high, but with the development in concrete technology the heavy loads imposed by skyscraper buildings can be carried on comparatively slender frameworks.

Much work has been done on new methods of placing concrete in the structure with the object of speeding up the building process, and reducing costs. One Swedish system, the Prometo method, has been successfully adopted in this country, and features a method of sliding shuttering. The principle of using such shuttering for reinforced concrete wall and column construction, which is erected at ground level, filled and then slid upwards instead of being dismantled for the next lift, has been in use for many years. The Prometo method, which was used for the first time for multi-storey buildings for the Birkenhead Corporation, provides a mechanical means of sliding the shuttering upwards to provide accuracy and speed. Shuttering is hoisted by hydraulic lifting jacks and the casting speed using this equipment is in the neighbourhood of 20 ft in 24 hours.

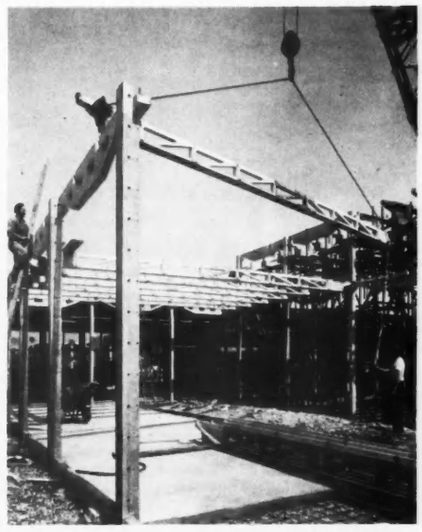
In the Birkenhead job, niches were boxed out in the walls during concreting to receive the beams of floors which were prefabricated. Window frames and other accessories were lifted into position before pouring and provision was made for conduits and pipes for the electrical and plumbing fixtures. Six sections of 10-storey maisonettes were erected in the record time of 19 days a section, and in all some 240 dwellings were provided on the site in 12 months. The cost worked out at £623 a head of person housed.

This is only one method offering savings in cost and time; others are being examined and developed. As the technique of concrete quality control is improved, with better methods of placing and compaction adopted from engineering practice, builders will be taking advantage of the higher strengths to exploit new forms and designs in construction.

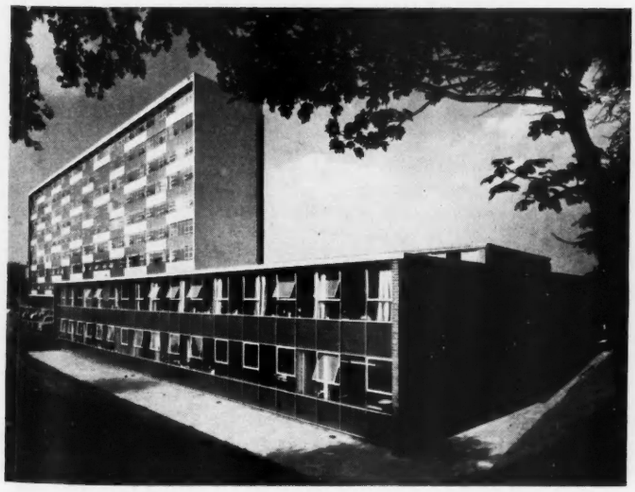
In the field of industrial building, the advantages offered by precast concrete units and structural steelwork have been pursued, and today a remarkable degree of standardisation has been achieved. Larger spans in steel and concrete have allowed considerable flexibility in solving the problems of uninterrupted floor space, in providing the best lighting by the arrangement of roofs in vaulting, domes or more familiar sawtooth profile, or in devising improved ways of accommodating special plant necessary in the new industrial processes. Although standardised, the modern factory need not look monotonous, for there are a variety of cladding materials or curtain walling to give individual treatment to the elevation.

The gap between building and civil engineering construction is not always apparent, many techniques are common to both, and others can be adapted in a number of ingenious ways. An example is the method of erecting the roof at a new hangar at Abingdon, where three bays each 186 ft by 110 ft are roofed by concrete barrel vaults, three to each bay and supported only by a column at each corner. The roofs were cast on the floor of the hangar, and travelling formwork built on bogies was used for each vault. The roof of each bay has a box beam on each longitudinal face, valley beams connecting the vaults and a gable beam enclosing each end. The beams were prestressed on the Freyssinet system. Each roof when completed weighed about 1,400 tons, and was then lifted by means of large

Continued on next page



Precast concrete units in school construction.



Typical of the new school buildings built since the Second World War, exploiting standardised components and units to achieve savings in cost.

Flats for Birkenhead Corporation, which were built using the Prometo system of sliding shuttering.

hydraulic jacks of 200 tons capacity. The jacks remained at floor level and T-shaped precast concrete columns units were inserted above them as the roof rose, being prestressed together when fully assembled. Four jacks at each corner lifted the roof to a height of 46 ft above ground level.

The method was economical, showing a saving in labour, scaffolding and plant, and casting at ground level is much more convenient than carrying out the work at high level. It is an example of the intelligent adaptation of engineering principles to building construction.

Something should be said of an innovation in building practice which is leading to improved methods and the elimination of waste time—the introduction of work study. Years ago most builders thought of work study as a good thing for the factory floor, but not suitable for building operations. Today, nearly all the national firms have work study departments and most of the medium and smaller firms are sending their executives to courses run by the Building Advisory Service to make them work study minded. Experience has shown that logical thinking, engineered by work study, and its detailed study of individual operations, multiple activity charts, plans, etc., have made a tremendous difference to output per man-hour.

Typical of improved methods resulting from work study is that following research into bricklaying. Although brick work is different in size and shape, it is erected in the same way. The corners are erected and the space between them filled in, whether the corners are 10 ft or 100 ft apart. Study of the operation revealed that to lay a corner brick took almost twice as long and was a more skilled job than laying centre bricks. It was traditional to build corners in 4 ft 6 in high stages, involving laying 72 " difficult " bricks in each corner. If this was done in two stages, each up to 2 ft 3 in, however, the number of difficult bricks was reduced to 40. Moreover, it was shown that the bricklayer by this method avoided much physical effort of continuous bending and stretching, and saved time in carrying out the laying process.

The operation of placing a screed to a roof 40 ft above ground level was recently studied. With a normal team of mixer and three men 48 sq. yd were laid each day, and because of the unbalanced nature of the team 65 per cent of their time was lost waiting for each other. Work study by introducing another mixer and mixer-man was able to reduce lost time substantially, and output rose to 122 sq. yd per day, with a reduction in plant and labour cost from 41*s* to 23*s* per cu. yd.

One of the more important factors affecting building methods has been the increasing amount of mechanical equipment now available to the builder. The emphasis today is on pre-planning and site organisation for the elimination of wasteful site labour and for speeding-up building operations, and in these aims machinery is making an increasingly valuable contribution. It is not too much to say that mechanical aids have revolutionised site work in the last decade; wasteful and laborious methods are giving way to mechanised operations and more and more appliances are being produced to meet the need for speed and economy.

The important thing is that mechanisation is no longer the prerogative of the large contractor. The smaller builder has found it to his advantage to use these appliances, and in turn the manufacturers are making available a range of equipment particularly suited to the needs of the medium-sized and smaller contractor. Consequently the industry is buying much more plant and machinery. Figures for capital expenditure on equipment over the last few years have more than doubled.

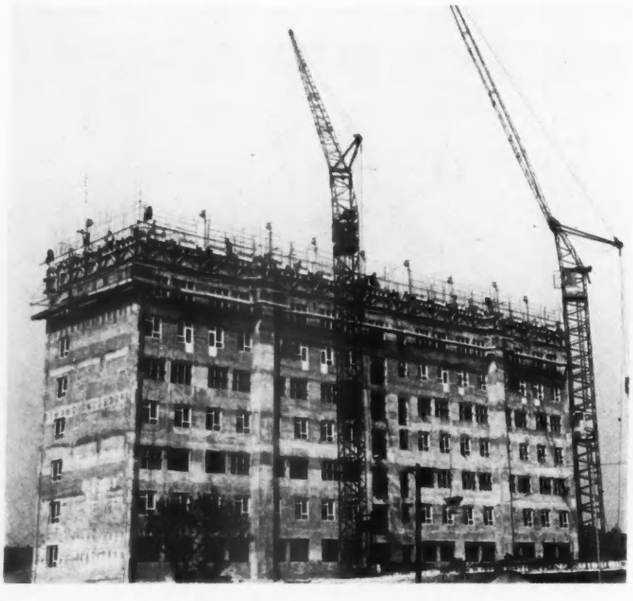
Some of the most spectacular advances have been made in the field of lifting and hoisting. The ubiquitous tower crane is the recognised symbol of mechanised building operations, and has done more than anything else to convince the public that building was not after all overlooked by the industrial revolution. The help to productivity in larger building operations is immense, providing the nearest conditions to factory line production that one can hope to achieve on site.

These big fellows are of course used only on the largest contracts, but there are few building jobs these days where a hoist of some sort is not used. A number of excellent and efficient types are available, easily transportable, sturdy, light in weight, simple to erect and work. This has become an essential feature of building equipment and there is now available a wide range offering a suitable machine for any condition of working.

Earthmoving machines are in growing demand; bulldozers, loaders and scrapers all have a important role on the building site. Builders look for versatility in this kind of plant; they want a multi-purpose machine which is capable of two or more functions, such as is provided by tractors fitted with a digger on the rear and loader on the front, or with a high-lift attachment.

A type of machine which can be adapted for many uses is the portable conveyor. A typical type is electrically driven from normal supply through a transformer or from a generator, and is suitable for handling aggregates or mixed concrete, for filling foundations, or for loading and unloading lorries. It can also be adapted for laying concrete floors *in situ* where the concrete can be delivered and spread by the conveyor at the same time.

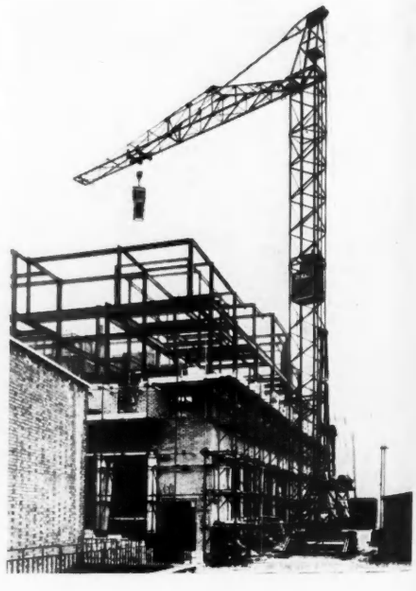
Another important development is the much greater use of small portable power tools on site. Traditionally, the British builder has achieved savings in the use of materials at the cost of wasted labour, while across the Atlantic, the American builder, generally speaking, would rather waste materials than waste labour saving it. We have been too wasteful of labour in the past, and one of the biggest factors in changing this is the advent of the power tool. This, with the use of mechanical equipment in practically every building operation, is helping to speed up production and to achieve full efficiency in the building industry.



(Above) Building high—as we know it. We can expect to see 20 or 30 -storey flats rising in the future.

(Left) A section of flats built with the Prometo system, during construction.

(Right) The ubiquitous tower crane, symbol of mechanised building operations.



Long Awaited Success

De Havilland's long devotion to the Comet moved a step nearer paying off with the formal handing over to British European Airways of the first of the pure jets. It was received by Lord Douglas, chairman of the Corporation.

Aircraft orders are extremely sensitive plants right up to the moment of flowering, but if things go well there are enough likely orders from overseas airlines to run into the £10,000,000's. Olympic Airways, the Greek airline, have ordered two Comets and Mexicana, of the distinctive circular gold tail marking, three.

BEA's two jets were Comet 4B's, handed over two months ahead of schedule, and one of them already in the Corporation's hands for crew training at Stansted in Essex. As Sir Aubrey Burke, deputy chairman and managing director of de Havilland, said at the Hatfield ceremony, keeping ahead of schedule was only giving BEA the service which the company had already achieved for BOAC with their Comet 4's.

The specification BEA gave for the new Comets was for better economics in operation and greater speed. De Havilland have come up with a plane with 15 per cent better operating figures and 30 m.p.h. on the speed. The Comet 4 has a normal cruising speed of 500 m.p.h. and the Comet 4B 530. For holidaymaking passengers flying over Europe it is worth adding that the 4B has a cruising altitude range of 20,000 to 38,000 ft, against 28,000 to 40,000 ft for the Comet 4. Weather allowing, this is sufficient to make some difference in what is seen.

Flight timings are reduced in almost sensational manner. Moscow becomes only 3½ hours away instead of 6¾. Nice 1¾ hours (2½). First routes to receive the speeded up Comet services, apart from *ad hoc* flights fitted in while training, will be to Rome, Athens and the Middle East. Moscow and Scandinavia come later.

Crew training—the Comet 4B's will have three-pilot crews, many of them recruited from Viscounts—has been a combined operation with BOAC and 216 Squadron, RAF Transport Command. The seven aircraft Comet fleet is expected to be fully operational by next July. A utilisation rate of 2,400 flying hours a year, plus the much greater average speeds, enable BEA to look forward to getting the same amount of work from the seven Comet 4B's as from a considerably greater number of Viscounts.

At Hatfield, as the gleaming Comets stood by in the dramatic red-black livery adopted by BEA, and the confident speeches were made, it was difficult not to speculate on what an impact on the world's airways the Comets would have made had it not been for their tragic early disasters. And if those first losses had not taken place, whether the turbo-prop Viscount would have enjoyed so prosperous an existence.

Air Traffic Control Cooperation

The growing interest by government in the improvement of air traffic control methods is the main factor in the entry of General Precision Systems in that field. This company, formerly Air Trainers Link Limited, have concluded arrangements with their sister companies in the General Precision group in the United States for complete access to the "know-how" and techniques acquired by the group in the development of new air traffic control systems for the Federal Aviation Agency.

The decision to enter the field of air traffic control systems and equipment for the United Kingdom, Commonwealth and European markets was announced last week by the chairman of General Precision Systems, Air Chief Marshal Sir John Baker. In association with Decca Radar they expected the air traffic control system to benefit greatly from the experience of Decca over the past ten years in the development of ground radar and display systems which must play an important part in any air traffic control system. The implementation of the new programme would eventually involve additional collaboration with other major companies in the British and European electronics industry.

Thornycroft Loss Analysed

Caught between the mass producing motor companies and reduced orders for military vehicles, the specialist vehicle builders, ship repairers and boat builders, John I. Thornycroft, have ended their year with a £65,214 loss, against 1958's profit of £208,901.

The chairman, Sir John Thornycroft, gives in his annual statement some lucid comment on how this happened. Nationalisation of road transport, followed by purchase tax on commercial vehicles, and before the election the further threat of re-nationalisation, combined to drive operators away from the more expensive specialist medium and heavy commercial vehicle and towards the cheaper, less highly taxed, quantity-produced products of the larger makers. By the autumn of last year it had become clear that it was not possible to obtain castings, tyres and equipment in comparatively small quantities at prices that allowed a chance of competing with the large motor-car commercial vehicle companies. Sir John reflects that with these companies low first cost is more important than low operating cost.

The removal by the electors of the road transport re-nationalisation threat, for some years, and the removal by Mr. Amory of purchase tax on commercial vehicles, leads to a revival of hopes that road operators will come back to specialist vehicles, thus obtaining lower running costs. The chairman sees that it will be a long job to change the trend to the policy of "buy cheap and scrap quickly." Any change that is effected will obviously help the specialist firm.

Intensification of effort to get the maximum capacity chassis in 4, 6 and 8 wheel classes, and specialist vehicles for use at home and abroad, has led to writing off some special tools, jigs and fixtures. Carrying out this policy, with the losses on sales during the year, accounted for the losses by Transport Equipment (Thornycroft) Limited. The Southampton organisation and Thornycroft's Singapore branch both returned profits for the year.

Midland Bus Retort

The correspondence columns of *The Times* have seen many a famous battle. But few have been over so swiftly as a motorway skirmish involving the Birmingham and Midland Motor Omnibus Company.

A *Times* reporter had stated the return fare by express coach service as £1 1*s* 3*d*, comparing it with the second-class rail fare of £2 2*s*. Smartly, an observant reader wrote in from Surrey to ask what proportion of the coach fare went towards road costs.

The facts came back without delay from Mr. D. M. Sinclair, general manager of the bus firm. In each single journey the company contributes 14*s* in fuel and road tax and each coach makes three such journeys a day. This adds up to a total annual contribution from a single bus of £750, a tidy sum, or in Mr. Sinclair's words—"a more than adequate contribution."

Buying for Size

Among the latest batch of mergers and acquisitions to be announced recently are Hilger and Watts' purchase of Infra-Red Development Company, which specialises in the manufacture of instruments for more non-dispersive infra-red gas analysis, a field which will be complementary to the dispersive techniques used by Hilger and Watts. Another is Mavor and Coulson's acquisition of Austin Hoy and Company (Holdings), who are manufacturers of coal cutting chains. As in the case of Hilger and Watts this provides the purchasing company with a complementary range of products which will fit in very well with their range of mechanical handling equipment.

American investment in Britain continues to grow. The latest large scale investment is a bid by IBM World Trade Corporation of New York for £9·8 million worth of shares in IBM United Kingdom held by minority holders. This represents some 38 per cent of the capital not already held by the US company. The reason given for this bid was that recent development, particularly in the European trading area, had shown that it was difficult to reconcile the interests of the minority shareholders with the necessity to integrate the business on a world wide basis. Earlier this month the Timken Roller Bearing Company of Canton, Ohio, acquired assets in the British Timken Company which has plants in England, South Africa, and subsidiaries in Canada, Germany, Australia and France. As in the case of IBM the object is to integrate the Timken organisation on a world wide basis. There is little doubt that the promotion of free trade, which has the support of most governments, is leading to the building up of strong industrial units able to look after themselves in a "free for all."

For Better . . .

Two very large engineering concerns announce slightly improved trading profits in the financial years ended 30 June and 31 July. Crompton Parkinson increased their net profits before tax from £2·69 million to £2·76 million and increased their dividends by 2 per cent to 14 per cent for the year. The board also recommend the capitalisation of £1·45 million of unallocated revenue reserves by allocating one 5*s* share for every four held.

Tube Investments have increased their profits for the year ended 31 July by £38,000 to £16·78 million. A final dividend of 12½ per cent makes the rate for the year 20 per cent and represents an increase of £576,000 in the amount paid out to ordinary shareholders. This encouragement to investors goes some way to justify the continuous rise in share values over the past 12 months and suggests an encouraging confidence in the future on the part of the directors of both companies.

. . . and for Worse

Substantially reduced profits were announced by Gloucester Railway Carriage and Wagon Company Limited, by £100,000 to £393,580. Another well-known engineering concern, Linotype and Machinery Limited (controlled by the Mergenthaler Linotype Company of New York), announced a fall in trading profits of over £200,000 to £830,000.

The chairman of Linotype and Machinery, Mr. V. E. Walker, said that throughout the year (ended 30 June) "trading conditions were difficult and continue to remain so." The reduced profit is mainly due to lower margins. Following the falling off in orders in the early part of the year and because of the build-up of completed machines, production had to be curtailed. Now that the order book justifies a higher level of production, it is stated, there is some difficulty in recruiting suitable labour.

General Sir William Morgan, chairman of Gloucester Railway Carriage and Wagon, explained that the fall in the company's profits was due primarily to a sharp reduction in orders for rolling stock in the home market and to the continued poor demand and low prices for grey iron, which reduced the profits of their subsidiary, Gloucester Foundry Limited. He criticised the declared policy of the British Transport Commission to keep their own workshops fully employed at the expense of the private rolling stock building industry.

Duration of Wind Loading on Buildings

The worst wind load suffered by a structure depends on the highest wind speed encountered. This speed varies with altitude and topography. The duration and frequency of gusts are also required when considering wind speeds.

By C. S. Durst, O.B.E., B.A.

With recent developments of high buildings the importance of wind effects on structures is becoming increasingly recognised; also with the use of lighter materials data are needed on the wind fluctuations in short periods of time, since these gusts are likely to affect the lighter members of a structure. Wind data are not generally available in this detail, so the present article has been written in an attempt to fill the gap; but, as will be seen, there are still important lacunae in our knowledge, which require the assembly of still further information.

It is not intended to describe here how wind affects a building since that falls in the realm of aerodynamics. Suffice it that the aerodynamic pressures are related to the squares of wind speed and that with modern light construction the critical time during which a gust affects a member may be of the order of 15 seconds, 5 seconds or even less. The meteorological statistics most readily available to describe the maximum wind speed are the hourly mean and the extreme gust. The former is not suited for discussing the effects on light buildings; the latter is rather an uncertain parameter, probably referring to a time interval of about 3 sec. However, to anticipate the result given later in this article, it can be said that for members affected by 15 second winds the hourly wind speed has to be increased by 40 per cent or more and for 5 sec winds by 50 to 70 per cent. This means that the aerodynamic pressures to be allowed for are twice or three times those that would be anticipated from the hourly wind statistics.

The architect and engineer, when planning a building, need to know what is the probable maximum wind speed at the height of the proposed building at the site chosen. Hence these notes are designed to give information on:
(*a*) how the maximum speed is affected by height above ground,
(*b*) what are the maximum speeds likely to occur in different topographical situations,
(*c*) how the time interval over which it is measured affects the specification of maximum speed.

With such information it is hoped that structural engineers and others may be able to design with greater precision.

Due to limitations of space it has not been possible to include the detailed reasoning by which some of the results have been reached. However, a manuscript version of the present article including those details has been lodged in the libraries of the Meteorological Office, London, the Institution of Structural Engineers, the Institution of Civil Engineers and the Building Research Station of the Department of Scientific and Industrial Research.

STRUCTURE OF WIND

If the wind structure is examined by means of an anemometer with an open scale and a response of about 5 sec, such as those used in experiments at Cardington in 1927-8[1], it is found that wind consists of the motion of parcels of air, some faster moving, some slower, some of greater dimensions, some of less. If one uses a still more sensitive anemometer, such as that used by Scrase at Porton[2] or by Sherlock and Stout at Ann Arbor, Michigan.[3, 4], the same sort of pattern is found, but on a finer scale, as is shown in Figs. 1 and 2. The Dines aneomometer, which is at present the standard instrument in the British Isles, is sensitive to about 3 to 5 sec and can be trusted to read the mean wind accurately over such a period, though it may read inaccurately over shorter intervals.

In general, the pressure on a building is proportional to the square of the wind speed of the parcel of air in contact with it, i.e. $(V + v_t)^2$ where V is the mean wind speed of the general air stream and v_t is the departure from it during a period t. The wind parcel causing such a pressure passes in time t and affects a dimension of t V at very nearly the same moment of time. For instance in a wind which averages 60 m.p.h. over a minute with gusts rising to 70 m.p.h. during 5 seconds, $(V + v_t)^2 = 4{,}900$ (m.p.h.)^2, which would operate during 5 sec over an area with linear dimensions 400 to 500 ft. Such an eddy might be embedded in an air parcel of speed 65 m.p.h. which passed in 20 sec and might be expected to operate over an area of dimensions about 1,500 ft. If the building is comparable with dimensions of 30 ft, and thus might be affected by a $\frac{1}{2}$ sec gust, then the speed might well be as much as 80 m.p.h. in this wind.

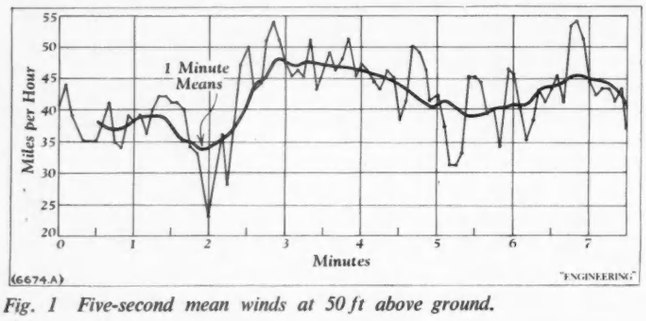


Fig. 1 Five-second mean winds at 50 ft above ground.

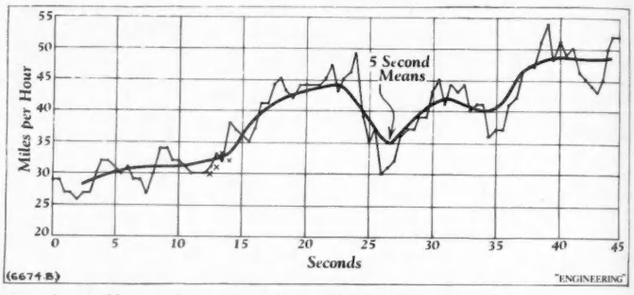


Fig. 2 Half-second mean winds at 50 ft above ground.

MAXIMUM WIND OVER THE YEARS

In the monthly weather report of the Meteorological Office there are recorded year by year the maximum hourly wind speed which has been measured at each of the anemometer stations of the British Isles. In 1936 Gold[5] summarised the data then available. If we wish to know the absolute maximum probable wind speed, the period of years over which we have records is of prime importance, Gumbel[6] has treated this theoretically. His argument is briefly this: if we measure the maximum hourly wind speed in each of a number of years, we can say there were so many years when the wind exceeded such and such a speed, so many when it exceeded a higher speed and one year when it exceeded a still greater speed, but we cannot say that if we took a larger number of years there might not be an even greater speed recorded. Thus the maximum speed is related to the number of years with records, and if a building is expected to last for, say, 10 years, the chance of it having to withstand the probable maximum wind is less than if it were expected to endure for 100 years.

Gumbel[7] gives tables for making the necessary calculations provided data are available to give, say, the maximum hourly wind speed (or alternatively the maximum gust) attained in each individual year for a considerable number of years. Shellard[8] has made both types of calculation for 48 anemometer stations in the British Isles and has published maps showing the values for probable occurrence once in 50 years.

The anemometers established over the British Isles are usually sited so as to give as "good" an exposure as possible, that is to say so as to record the speed of the wind blowing over level country with an unobstructed flow. Furthermore, the object is to obtain wind speeds at comparable heights above ground, the height chosen being 10 metres (or 33 ft) and an adjustment is made to the recorded speeds to bring into line the measurements from anemometers at heights other than this, allowance being made for neighbouring obstructions in this adjustment. This very necessary modification is further complicated by the fact that the variation with height of the mean wind speed is different from that of a 5 second gust. Therefore the adjustment of Shellard's maximum gust values has had to be made by a different formula from his mean hourly winds.

From Shellard's maps one may draw broad conclusions for the British Isles; they are applicable to open sites in level country on the basis of one occurrence in 50 years:

(*a*) The highest hourly wind speed experienced attains to about 70 m.p.h. on exposed western coasts with extreme (5 second) gusts of between 100 and 110 m.p.h.

(*b*) On exposed eastern coasts the highest hourly wind speed is something over 60 m.p.h. with gusts of about 100 m.p.h. However the effect of the Grampians is apparent at Aberdeen and Balmakewan in a reduction of both the hourly wind speed and the gust.

(*c*) Inland there is generally a lowering of both the maximum hourly wind and the maximum gusts by about 10 m.p.h., but where a station such as Eskdalemuir Observatory, Dumfries, is itself at a high level this reduction does not hold.

(*d*) In extensive built-up areas (e.g., London, Birmingham, Glasgow) the maximum hourly wind is cut down by a further 10 m.p.h., but the maximum gust is likely to be of the same magnitude as over open country.

WIND VARIATION WITH HEIGHT

The data given above referred to the standard height of 33 ft above ground level. Over open level country the variations with height of both the mean wind and the gust velocity have been examined by Deacon.[9] Deacon used observations made at Sale, Victoria, Australia, on anemometers mounted at 40, 210 and 503 ft over open country. These anemometers were sensitive to changes in 2 sec intervals of time.

The law for the variation of wind speed can be conveniently expressed as

$$\frac{\bar{u}_z}{\bar{u}_a} = \left(\frac{z}{z_a}\right)^{\alpha}$$

where u_z is the wind speed at height z, u_a that at a reference level z_a and α is an index which Deacon shows to lie between 0·16 and 0·26, and which is usually taken as 0·17 for open country in the British Isles. Deacon has also discussed the variation of gust speed with height and finds that the same law holds but with an index of 0·085, at any rate to a height of 300 ft.

Taking these values of the indices and comparing with winds at the standard height of 33 ft we get Tables I and II, table I for the variation of hourly wind speed, table II for the variation of maximum gusts (2 sec).

TABLE I.—*Variation of Hourly Wind Speed with Height*

Height (z), ft	33	50	100	150	200	300	400	500
$\frac{u_z}{u_a}$	1·00	1·07	1·21	1·29	1·36	1·46	1·53	1·58

TABLE II.—*Variation of Two-second Gust Speed with Height*

Height (z), ft	33	50	100	150	200	300	400	500
$\frac{g_z}{g_a}$	1·00	1·04	1·10	1·14	1·17	1·21	1·24	1·26

If then we know, or can estimate, the maximum hourly wind at the standard level or the probable maximum gust, we can give an estimate of the suitable values for any height up to 500 ft, but it must always be rememberd that it is assumed in these tables that the country is level and open.

EFFECTS OF TOPOGRAPHY

Topographic effects may be broadly classified as:

(*a*) Coastal and inland exposures
(*b*) Hillslope exposures
(*c*) Valley exposures
(*d*) Woodland and town exposures.

(*a*) *Coastal Exposures in Contrast with those Inland*

It is common knowledge that the wind speed in an on-shore gale is greatest on the coast; even 5 or 10 miles inland there is a notable decrease in the wind speed. The strongest winds over the British Isles are in general from between SW and NW, hence coasts exposed to these directions have the greatest wind speeds. However, the coasts of SW Scotland, Northern England and North Wales are not so liable to violent gales as are the coasts of South Wales on the one hand and the Hebrides on the other, for Ireland affords some protection to these coasts. The eastern coasts, and in particular the SE coast of England, are less liable to very strong winds than are the south-western coasts; the Hebrides and north-western coasts of Scotland are particularly exposed. Of course, sites on bluffs and cliffs are more liable to the strongest winds than are those on flatter coasts at a lower level.

Over the open sea the ratio of the maximum gust to the mean wind is smaller than over land and this applies to some extent at well-exposed coastal stations away from cliffs and obstructions (which themselves create turbulent eddies). Broadly speaking, the extreme 5 sec gust velocity at coastal stations is about one and a half times the maximum hourly wind, compared with about one and three-quarter times at inland stations.

(*b*) *Hillslope Exposures*

An important factor in wind exposure is the slope of the ground, but all too little is known quantitatively of its effect on mean winds and gusts. Qualitatively, we may draw some conclusions.

In Fig. 3 a section is shown of a ridge 100 ft high rising abruptly out of a level plain and we require to know about the wind at a level 30 ft above the crest of the slope, e.g., at point A. We know from Tables I and II that the ratio of the wind speed at 130 ft at point B is about 1·25 of the mean speed at 30 ft (point C). The mean wind at 30 ft over the crest of the hill is certainly considerably more than at point C, and is probably not far short of the speed at point B; so we can expect the wind speed at A to be about a quarter as much again as that at 30 ft over the plain; however, the gust value at point A is not likely to be increased by more than one-eighth over that in the plain (point C).

The case cited has been purposely rather an extreme example and with a simple form for the hill; with less abrupt slopes the excess of speed on the hillside may be expected to be less.

In particular the example given is for a ridge at right-angles to the wind stream. A conical hill could not be submitted to the same argument with any degree of accuracy. This is because air could pass round the flanks of an isolated hill and one may surmise that the wind speed over the summit of such a hill might be less than at the same level over a plain, because the hillside might slow down the general air flow.

The whole question of the air speeds on hill slopes is largely unexplored and even the estimates given above can only be looked on as surmises which may serve as a guide until other more reliable data become available.

(*c*) *Valley Exposures*

An effect on wind which is most marked in certain ravines and gorges can be seen even in more open valleys. Indeed, it is common experience that a strong wind blows even more strongly down a valley, provided its general direction is along the valley. Each valley need separate consideration, but it seems the strongest "funnel" winds occur in valleys with fairly steep sides and with the characteristic that the valley leads up to a pass in the hills, or even penetrates through to low-lying country on the far side.

During the war a number of such cases were noticed in various parts of Europe where the "ravine effect" was very pronounced. A ravine effect at Stranraer causes winds to be much stronger than would be expected over open country. A remarkable wind was recorded at the wartime airfield of Milfield, Northumberland. Details of the observations are reported by Dr. Jane Meiklejohn[10]; she found that during the first six months of 1945 the wind attained force 6 on more than 93 days out of 181, and there were 27 days of gale force. This is a much higher frequency than at other stations in this neighbourhood. During 90 days between 17 January and 18 April there were 109 hours of gale force winds at Milfield, nine of which were force 10 (55 to 63 m.p.h.) and five were force 11 (64 to 72 m.p.h.).

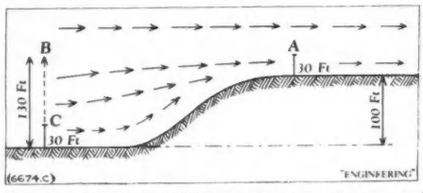


Fig. 3 Section of hillside showing direction of air currents.

The airfield at Milfield is situated a mile or two ENE of the mouth of the valley through which the River Glen debouches from the Cheviot Hills. Dr. Meiklejohn reports that owing to the prevalence of the strong westerly wind small trees in the neighbourhood of the airfield were bent towards the east and that this was apparent over an area of the Till Valley about two miles wide and three or four miles long. Moreover, she found that the exceptionally strong winds were confined to about 100 ft above the valley bottom. We have no data of the magnitude of wind velocity at this site in periods of 3 to 5 seconds, but with winds of force 10 or 11 the gusts must have risen to 100 m.p.h. or more.

The topography of the valley of the Glen is by no means exceptional; it may be suspected that the ravine effect may be found in very limited areas in a number of the valleys running down to the east in many parts of the British Isles; the presence of these winds may be known to the local inhabitants as an inherent evil and may be apparent to the newcomer by bent and wind-blown trees. To some extent the likely sites may be recognised from moderate scale maps, though the limited extent of these strong winds makes their assessment particularly difficult; in the British Isles where on the whole strong winds occur predominantly from directions NW, W and SW, the dangerous low-lying sites are probably those in and opposite narrow valleys that penetrate deep into mountains and run in a general direction of NW-SE, W-E or SW-NE.

(*d*) *Woodland and Town Exposures*

Trees form efficient windbreaks and are used often for this purpose. An extensive area of trees (or houses of varying heights) tends to reduce the mean speed of strong winds by the friction of the surface. Notable examples of the town effect in the official records are Kew Observatory, London (Kingsway) and Birmingham, where the probable maximum hourly speed in 50 years is about 10 m.p.h. less than at comparable country stations; it would also seem that the woods to west of Rothamsted Experimental Station, Harpenden, have an appreciable effect in slowing the wind speed of westerly winds there. However, in the case of gusts the slowing up is not so pronounced.

Though the presence of houses and trees may appear to give shelter, this shelter may not be so effective if the building is of light construction and for that reason is more likely to be affected by gusts.

On quite a different scale is the eddying produced by high trees or by buildings at a site some hundreds of feet to leeward. A very notable example of this effect was found when an anemometer was erected at Lizard lighthouse. The site of the anemometer proved to be at the focus of the eddies caused by a row of houses about 30 ft high lying about 100 ft away. A description of the observations and experiments made to cope with the erratic behaviour of the anemometer is given by Thomas.[11] When the head of the anemometer was at 40 ft above ground level the eddies produced wild fluctuations of speed as soon as the wind was in a direction passing over the houses. On one anemogram there are indications that in gusts the air speed increased from 20 to 50 m.p.h. owing to the houses, with wild eddying. By raising the anemometer head to 75 ft an exposure was obtained which was free of these turbulent eddies.

It is notable that this effect was apparent in the damage done to roofs at Hatfield on 4 November, 1957; in at least two instances there was extensive damage done to the first and third of three rows of houses spaced at about 100 ft intervals, but the middle row was undamaged.

WIND SPEEDS OVER SHORT PERIODS

In a review such as this some mention must be made of the chance of violent winds in the small tornadoes which occasionally are reported in the British Isles. They are small vortices which form under violent convective clouds, e.g., in fronts and thunderstorms. In general the destructive force is due not only to the violence of the wind, but also to its rapid change in direction and the twisting effect which shears off the tops of trees, etc.; in addition the very low pressure in the centre of the tornado may cause a closed building to explode outwards, if the centre of the tornado passes over it, for the pressure at the centre may be reduced by 30 millibars in one minute or less.

So far the data shown have been either for a wind taken over an hour or for a gust which is believed to represent a velocity of about 5 sec duration, nothing has been said of wind velocities which may affect buildings for, say, 30 sec, or one minute, mainly because the usual Dines anemometer does not exhibit a trace from which the speed in such intervals of time can be measured. However, intervals of one minute, 30 sec or even ½ sec may be of interest to the engineer and with the aid of the work done at Cardington

Continued on next page

and at Ann Arbor it is possible to give some indications. As the basis of the calculation is rather complicated only the general result is shown below, but further details are available in the full manuscripts already mentioned if needed.

If an estimate of the mean hourly wind speed has been made for a certain place, on a certain occasion, and it is required to know what was the chance of maximum wind speeds during a much shorter interval of time within that hour, the information can be obtained by multiplying the mean hourly wind speed by the factors given in Table III.

For instance, if the mean hourly wind on a certain occasion is 40 m.p.h., there are even chances that during a period of one minute in that hour the mean wind would be 50 m.p.h. or more and there would be a chance of 49 to 1 against there being a one minute speed of 56 m.p.h. On the other hand, if 5 sec mean speeds are of importance, the chances are even that during an hour with a mean wind speed of 40 m.p.h. there will be a 5 sec gust with a speed of 59 m.p.h., and the odds are 49 to 1 against a 5 sec gust of 66 m.p.h. or more.

These factors are based on the assumption that the wind distribution follows the normal gaussian law. This is only approximately true; nevertheless we may be fairly confident that the results are sufficiently accurate for working purposes.

TABLE III.—*Factors for Converting the Mean Hourly Wind Speed into the Maximum Gust Speed likely to Occur during that Hour, the Guests being Averaged over intervals of 1 min down to ½ sec.*

Time interval	Chance against				
	Evens	4 to 1	9 to 1	24 to 1	49 to 1
1 min. ..	1·25	1·32	1·35	1·38	1·40
30 sec. ..	1·32	1·40	1·43	1·46	1·49
20 sec. ..	1·36	1·44	1·46	1·50	1·53
10 sec. ..	1·43	1·49	1·53	1·56	1·59
5 sec. ..	1·48	1·56	1·59	1·63	1·66
½ sec. ..	1·63	1·70	1·74	1·77	1·79

Acknowledgement.—I am indebted to George Wimpey and Company who first pointed out to me the need for the restatement of this problem. Subsequently I have been much helped by comments and criticism from Mr. R. E. Lacy, of the Building Research Station, and from the Climatological Division of the Meteorological Office, and also by the advice of Mr. R. T. James.

References

[1] Giblett, M. A., *et al.* "The Structure of Wind over Level Country," *Geophys. Mem.* 54, London, 1932.
[2] Scrase, F. J. "Some Characteristics of Eddy Motion in the Atmosphere," M.O. *Geophys. Mem.* 52, London, 1930.
[3] Sherlock, R. H., and Stout, M. B. "Picturing the Structure of the Wind," p. 358, *Civil Engineering*, June, 1932.
[4] Sherlock, R. H., and Stout, M. B. "Wind Structure in Winter Storms," p. 53, *Journ. Aeron. Sciences*, 5, No. 2, December, 1937.
[5] Gold, E. "Wind in Britain," p. 167, *Q.J.R. Met. S.*, 62, 1936.
[6] Gumbel, E. J. "Statistical Theory of Extreme Values and Some Practical Applications," US Dept. of Commerce, National Bureau of Standards Applied Mathematics, Series 33.
[7] Gumbel, E. J. "Probability Tables for the Analysis of Extreme Data," US Dept of Commerce, National Bureau of Standards, Applied Mathematics Series 22.
[8] Shellard, H. C. "Extreme Wind Speeds over Great Britain and Northern Ireland," p. 257, London, *M.O. Meteorological Magazine*, 87, Sept., 1958.
[9] Deacon, E. L. "Gust Variations with Height up to 150 m," p. 562, *Q.J.R. Met. S.*, 81, 1955.
[10] Meiklejohn, J. "The Local Wind at Milfield, Northumberland," p. 468., *Q.J.R. Met. S.*, 1955.
[11] Thomas, M. J. "Notes on the Behaviour of the Anemograph at Lizard," Air Min. Prof. Notes, 73, 1936.

Telephone Exchange Uses Computer Techniques

A prototype electronic exchange has been installed at the Post Office Research Station at Dollis Hill, London. It represents the outcome of cooperative research between the GPO and five companies. The move to electronics has been made because conventional methods using electromechanical relays are approaching the limit of their development capability. When the prototype exchange has been thoroughly tested, equipment for about 1,000 lines will probably be installed for the public exchange at Highgate Wood. The installation is likely to be ready in about two years.

The new exchange uses solid-state devices and digital computer techniques. But whereas the switching systems in operation in the exchange are very similar to those found in a computer, they have the additional task of carrying speech and various other signals.

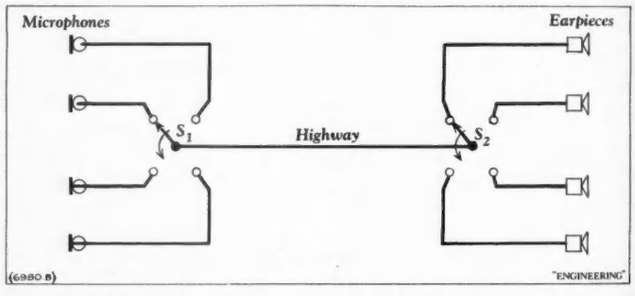
Within the exchange, time division multiplex is used to marshal 100 conversations on a single circuit or "highway." Each highway serves a group of 800 lines; and although the number of lines is several times the number of conversation channels, subscribers use their lines with sufficient infrequency for this to present no problem.

A rotating magnetic drum is used as a semi-permanent memory. It acts as an exchange library, carrying all information relative to subscriber's lines and junctions. Another part of the drum cooperates with the register equipment by providing translation facilities for routing the call. Positions on the drum are also allocated to each subscriber, for a record of the accumulated fee.

The principle of the time division multiplex system may be simply described as follows. If S_1 and S_2 are synchronised and switch each microphone to its corresponding earpiece very rapidly, it is possible to transmit four conversations over the single highway without mutual interference—provided the interruption of the speech by the switch is too rapid to be noticed. Changing the synchronisation enables different connections to be established. In Dollis Hill exchange, this principle is used to pass 100 conversations over a single highway, the switching cycle repeating 10,000 times a second. The switching is carried out by semiconductor diode gates. Thus, rapid interconnection of telephone sets is obtained without the use of moving mechanical contacts: maintenance is reduced and operating speed increased.

(*Left*) *The register equipment receives the digits dialled by the subscriber and uses them to set up the call.*

(*Right*) *By rotating synchronised switches (S_1 and S_2) at high speed, many signals can be sent over one highway.*



In the Dollis Hill laboratory model, the multiplex cycle repeats 10,000 times per second, each speech circuit being connected for 1 microsecond per cycle. Exchange lines are connected by electronic gate circuits to their highway, which can be connected to other highways by further gate circuits. Magnetostrictive delay lines are used as temporary memories in register equipment for storing dialling pulses arriving at subscriber's gates for connection to the highway. The delay lines count and store dialled pulses, obtain any translation to route calls to other exchanges, and transmit digit pulses (to serve the needs of conventional exchanges) when outgoing routes are established. Delay lines also supervise connections after they have been made. They connect tones to the calling lines and ringing to the called lines, detect answering and clearing, and arrange for the metering of completed calls.

VACUUM SCIENCE COMMITTEE

Following the Institute of Physics' London conference on high vacua, which was held last April, a Joint British Committee for Vacuum Science and Technology has now been formed. Resulting from informal discussions between societies and institutes in this country, the Committee consists of representatives from ten scientific and industrial bodies.

The objects of the Committee are: (*a*) to coordinate and help to initiate meetings in the whole field of vacuum science and technology arranged by constituent bodies, and (*b*), to act in the collective interest of the constituent bodies by maintaining liaison with the International Organisation for Vacuum Science and Technology and with national vacuum societies.

On the Shelf

By Frank H. Smith

It is quite obvious that the new Colleges of Advanced Technology cannot have yet acquired adequate libraries to cope with the influx of students. In fact, it is a moot point whether the library will ever keep pace with the demands made upon it by the particular student type that the colleges attract. What contribution can the established special libraries make to this new educational stratum? How far will the regional library systems be affected? How far are local authorities prepared to go in coping with this aspect of advanced education? A year or two back Aslib had an all-day conference on the subject. I wonder if anything came of it.

If you get cracking and send your 30*s* along to Aslib, 3 Belgrave Square, London, SW1, you can attend an all-day conference on "Information in the Building Industry," at the Connaught Rooms on 9 December. The 30*s* includes the mid-day beanfeast. The morning session deals with existing services and what the industry wants. The afternoon is a panel discussion with a panel made up of "users" and "purveyors," with a neutral panel master.

Did you know that Western Europe had the greatest percentage rise (15) in oil consumption for 1958 as compared with 1957? The USA had only 3 per cent, but then the USA consumed 437 million tons as compared with Western Europe's 156 million. On the other hand, the Middle East had 62 per cent of the world's total reserves at the end of '58 and the USA had 13 per cent. The USSR had 10 per cent. Such facts as these will have the Little Woman and the kids goggle-eyed and you can swot up plenty more with the help of *BP Statistical Review of the World Oil Industry 1958* (from British Petroleum Company Limited, Britannic House, Finsbury Circus, London, EC2). Last year, if I remember rightly, I quoted this publication as providing material for sherry party conversations. This year I bring it into the heart of the family. It's part of the move to do away with the expense account.

Collins (14 St. James's Place, London, SW1) have one of the most striking covers I have ever seen for a bookseller's list. It is perfectly plain with the legend "Collins Autumn 59." No other adornment and the lettering isn't all that big. It is rather like those very chic hat shops with just one little hat in the large window. Funnily enough, Collins "blame" the printing dispute for this precedent.

The Technical Service Department of CIBA (ARL) Limited of Duxford, Cambridge, issues technical notes from time to time. No. 202—the latest (I deal only in the latest)—is "Hyperbolic Paraboloid Roofs." Can't stop to explain what CIBA or ARL stands for—or Hyperbolic, etc., roofs, but if you want a copy take my word for it that that's the address you want.

I know some irritating types who, when you offer them a book of raffle tickets, spend half an hour trying to find prime numbers (I always add my digits to make 13). They can now cut down the time wasted with the aid of the Microcard Foundation's (Box 2145, Madison 5, Wisconsin) $35 microcard edition of "The First Six Million Prime Numbers," by C. L. Baker and F. J. Gruenberger. If they don't find their raffle ticket in that lot they should keep their tanners.

Gauthier-Villars of 55 Quai des Grands-Augustins, Paris 6e, now have their 1960 catalogue ready. Part II (I think it is—it may be 11) collects together sciences medicals and biologics and sciences applieds and technique.

Does "desiderata" mean they want it? If it does and you have some files of old journals you wish to flog, write to Santo Vanasia, 71 via Mauro Macchi, Milano, and ask him for his latest list of desiderata.

ANATOMY OF AMERICAN BUILDINGS

Materials and Methods of Architectural Construction. Edited by HARRY PARKER, CHARLES MERRICK GAY and JOHN W. MACGUIRE. 3rd edition. *Wiley, New York; Chapman and Hall, London.* (96*s*)

Books about building construction for one country are seldom very useful for work in another, and this is no exception. For example, there is an emphasis on timber construction for houses, which we seldom use, but the cavity brick wall which is our norm is not discussed. Roofs, chimneys, fire protection of steelwork, floor construction are all more or less different, and there are many differences in materials and manufactured products. A curious item, for example, is something called an English tile, a sort of flat pan-tile, not even known here. It would be wrong therefore to encourage students to use the book as a basic text.

It is nevertheless a comprehensive textbook and covers materials, construction details, structural mechanics and foundations. Its main alternative function would be as a library reference for purposes of comparison and study.

To most British readers with this particular interest a curiosity will be the recurring references to construction for a classical appearance, with all the familiar cornices, moulding, arches and string courses. Even the gothic flying buttress is brought in. All these are presumably still necessary in the United States, but they have disappeared from recent British books. The relatively few designers still working in this vein in Britain would find it of value perhaps. Again unexpectedly, there is no reference to curtain walls as we know them; the term is used but to these authors it apparently means non-loadbearing masonry cladding of frame structures.

A surprise of another kind is a good description of fireplace and chimney construction, with information not known here. In the same category is a description of cladding steelwork by special clay or plaster products for fire protection, an old-established American practice which ought probably to have been "worked-over" here long ago. Our customary dense concrete protection is summarily dismissed as too heavy. Such comparisons as these are stimulating.

It is worth giving a moment's thought to the suitability of this form of book for its purpose. In particular, is it wise to embrace structural mechanics, from a conventional computational standpoint with the normal constructional information? The brevity and simplicity of treatment is commendable, but the section seems out of place nevertheless. Perhaps a somewhat different treatment of it redirected to the specific needs of architects and construction people would be more satisfactory.

W. A. ALLEN

BUILDING IN TERMS OF DUCTILE COLLAPSE

Plastic Design of Steel Frames. By LYNN S. BEEDLE. *Wiley, New York; Chapman and Hall, London.* (104*s*)

The plastic collapse method of analysis and design for ductile structures has been largely developed by Professor J. F. Baker and his colleagues at Cambridge. The theory, which involves consideration of the total energy absorbed in plastic deformation of a building rather than the elastic limit of its constituent members, is now well established, and the economies in structural steel that it permits widely recognised.

Quite a few structural engineers in this country managed to obtain copies of a published booklet, *Plastic Design in Structural Steel*, which was produced as a bound set of lecture notes for a summer course at Lehigh University in 1955. This booklet was prepared by Professor Beedle in conjunction with his colleagues B. Thürlimann and R. L. Ketter and was clearly planned for the instruction and guidance of the practising steelwork designer. The style and coverage of this new volume are almost identical with that of these earlier notes, though the presentation is rather more professional and the classroom explanations, omitted from the notes, have been incorporated in the text. The presentation, which was excellent in the notes, reaches a correspondingly high standard in the textbook, and the exposition is clear without being either verbose or terse. It is difficult to imagine a more effective work with the same objective, which is to enable structural designers to understand and successfully apply the plastic collapse method of design to suitable structural frameworks.

The first chapter (the introduction), argues the case for the use of the load factor and plastic design for ductile structures quite convincingly (without, however, so much as a mention of the anomalous treatment of the strut in conventional design). The bending of beams is considered in the second chapter, again quite adequately, but without any discussion on the difficulties of reconciling the results of the elastic and plastic methods even in the design of simple beams. The next chapter deals with the three basic requirements for a satisfactory plastic analysis of any rigid-jointed structure; these are that static equilibrium should always be satisfied, and that a collapse mechanism should develop by yielding at correctly assumed sections only. These conditions can sometimes be achieved together, as in the graphical method explained in the British Constructional Steelwork Association booklets, or by some guided trial process, such as the "mechanism method" due to Neal and Symonds or the pseudo "moment distribution" technique due to Horne and English (evolved independently). These methods are explained quite well, though the graphical method has rather more scope than is allowed here.

The theory covered in these first three chapters, which takes up less than one-third of the book, is utilised as the main analytical basis for the subsequent design procedures. Thus, the fourth chapter is concerned with "secondary design problems," that is, the effects of axial and shearing forces, of instability, brittle fracture and repeated loading in reducing effective plastic moments of resistance. The design of various types of connection are considered in the following chapter, and the calculation of deflections is the subject of the chapter after that (chapter 6). These three chapters are all concerned with possible limitations to the simple plastic collapse theory; the designer is shown how to allow for each effect and difficulty.

The final three chapters are concerned with design procedures and examples. The first of these explains the general design approach, the next deals with the design of continuous beams, and the last chapter is concerned, at some length, with single-bay, multi-bay and multi-storey steel frames. There is obviously a fund of design experience embodied in this final section, and the earlier part of the book builds up to it nicely. The volume concludes with a set of references, a short appendix on the spacing of lateral bracing and a second appendix listing the plastic moduli of wide-flanged beams.

Plastic Analysis of Structures. By PHILIP G. HODGE, JR. *McGraw-Hill.* (81*s* 6*d*)

In the development of plastic theory by Professor J. F. Baker and his colleagues at Cambridge attention has been given both to theoretical developments and their application to design. No American university seems to have adopted the same approach; for example, the research at Lehigh has been aimed at perfecting the design

Continued on next page

method and that at Brown University to advances in pure analysis. The recent textbooks by Professors Beedle and Hodge demonstrate this division of interest.

The plastic analysis of structures is admirably treated in this new book by Professor Hodge, who writes with the clarity and rigour of an applied mathematician. The bending of beams and frames is the subject of the first part, which occupies just over half of the volume, and is composed of chapters entitled: limit analysis of beams and simple frames, methods of limit analysis, examples of framed structures, developments in plastic beams and frames, general loading, limit design and axial forces in frames and arches. Most of this is now conventional teaching material in present-day degree courses in civil and structural engineering, but the presentation here is particularly attractive and clear. Most of this information is already available in *The Plastic Methods of Structural Analysis* by Professor B. G. Neal and *The Steel Skeleton*, Volume 2, Plastic Behaviour, by Professor J. F. Baker, Dr. J. Heyman and Dr. M. R. Horne, both of which are published here. The problem of instability is, somewhat surprisingly, completely overlooked in this new book, but the reader may refer to *The Steel Skeleton* for a theoretical treatment of this problem, or to *The Plastic Design of Steel Frames* by Professor Beedle for design allowances.

Structures under combined stresses are considered in the second part of this work. This is a very interesting theoretical section, consisting of chapters entitled: general theory of combined stresses, bending of plates, limit analysis of shells, problems in plane stress and impact loading of plastic structures. The general theory of plasticity, involving combined stresses and plastic flow, has been largely the concern of the mechanical engineer in its development to date, but there are important structural forms to be studied in their plastic behaviour. Previously available literature has been too unrelated and formidable to give much encouragement to the structural engineer, but this new book, in the second section, should expedite the application of this relatively new theory to actual design.

E. LIGHTFOOT

SYNTHESIS IN CONCRETE

Proceedings of a Symposium on the Strength of Concrete Structures. London, May, 1956. Organised by the Cement and Concrete Association in conjunction with the Joint Committee on Structural Concrete. Editor: RALPH P. ANDREW. *Cement and Concrete Association.* (£5)

The symposium on the Strength of Concrete Structures, which the Cement and Concrete Association organised in London in 1956, is believed to have been the first of its kind anywhere. The post-war spate of symposia is deprecated by some, but provided that they are not overdone, there seems to be no better way of getting to grips with specialised subjects.

The theoretical analysis of the static behaviour of concrete structures had a chequered life early in this century, but by 1916 had settled down to a linear elastic theory in common with other structural materials, and this elastic theory formed the basis for design.

Research had never ceased to be concerned with the analysis of the state of concrete structures at failure, but this work only became interesting to the practising engineers with the renaissance of the load-factor method of design which appeared seriously in Britain just before the Second World War. The subject has now become one of keen interest and has already worked its way into codes of practice.

The volume is divided into five sessions, which are concerned with: statistical theory of loading and strength; the strength of concrete members; the strength of concrete framed structures; the strength of special structures and structures under special loading conditions; and the practice of concrete structural design using load factor methods. In all there are 17 papers with their associated discussions collected in 697 pages.

The three papers of the first session present three different but related aspects of the study of structural loading. Dr. Horne discusses the evaluation of statistical parameters from the few extant studies of actual loads in buildings, and proceeds to consider the implications of this in the collapse mechanism of frames. Dr. Johnson shows how statistical results from the strength of materials, constructional workmanship and loading have been used in Sweden to form the basis of the design of reinforced concrete slabs for the floors of buildings. Sir Alfred Pugsley discusses in general terms the basis of modern ideas on structural safety.

The five papers of the second session are concerned with various problems in the strength of concrete members. Dr. Mattock discusses in great detail the accepted theory for the flexural strength of single reinforced concrete beams in bending and shows the relationship between various parameters in the light of a large number of recent tests. Mr. Armstrong reports studies of concrete members in combined bending and tension. While the theory cannot be said to be established at present, the results of tests, which are included, will be of great value in this difficult field.

Professor C. P. Seiss in his paper on prestressed concrete members devotes considerable attention to the effect of bonding of tendons which has been recognised as an important factor in the ultimate moment of resistance of prestressed sections.

Dr. Könyi and Mr. Lewis report tests on reinforced concrete beams using plain mild steel and deformed high-tensile steel for comparative purposes. The tests were designed to compare with those of Glanville and Thomas, where two-span beams were used to measure moment redistribution at loads approaching failure. These recent tests showed full redistribution when high-tensile steel was used. In the final paper, Mr. Harris discusses the failure of concrete under combined stress along the lines originally suggested by Coüard in France.

The third session began with a paper by Professor A. L. L. Baker on the ultimate load design of concrete frames. This seems, in many ways, to be a review of the whole study which the Imperial College team have carried out in the past ten years. The second paper is by M. Guyon on prestressed concrete frames, in which he develops methods for design based upon ultimate strength theory and the results of tests.

The strength of prestressed concrete continuous beams and simple plane frames by Mr. Lewis and the present reviewer is a theoretical and experimental study of moment redistribution at ultimate load in structures having one degree of indeterminacy. Full redistribution is shown to occur in the structures tested.

Mr. Seddon's paper, the first in the fourth session, reports work he has carried out at the Building Research Station on the strength of concrete walls under direct and eccentric axial loading. This "column" study is unusual in that the effects of cut-outs in the structure are considered. Dr. S. C. C. Bate reports studies of fatigue and impact loading of concrete members. Fatigue resistance is found to be adequate. The effects of impact loading on reinforced and prestressed members are found to be different. Reinforced members have a large capacity for energy absorption with large permanent set, while prestressed concrete absorbs less energy but has very great recovery. Shear failure appears to be more important than in static loading. Mr. Reynolds and the reviewer discuss the theory and experimental results of tests of slab bridge decks under concentrated loads. The yield-line theory provides a very good description of the failure mechanism and estimate of the failure load. It is shown that, if slab bridge deck design were carried out in this way, very small percentages of transverse steel would be acceptable in design. Tests on open grillages showed that it was not possible to carry over yield line theory, since torsion appeared to have an important effect.

In the last session, Dr. Hognestad, Dr. Jacobsen and Dr. Matthews reviewed current thoughts in America, Norway and Britain on the codification of knowledge of the strength of concrete structures into design specifications.

P. B. MORICE

The Reviewers

Mr. W. A. Allen is chief architect at the Building Research Station. He was born in Canada, where he obtained the degree of B.Arch., and came to England in 1936. After practising architecture in this country, he joined the Building Research Station shortly before the war. He is an associate of the Royal Institute of British Architects and a member of the Illuminating Engineering Society.

Dr. E. Lightfoot is reader in civil engineering at the University of Leeds. He serves on the British Standards committee for "Maximum Permissible Stresses in Cranes," and is a member of council of the Institution of Structural Engineers.

Professor P. B. Morice occupies the chair of civil engineering at the University of Southampton. He served previously with the Cement and Concrete Association as head of the structures laboratory at Wexham Springs, and is a D.Sc., a Ph.D., an A.M.I.C.E., and an A.M.I.Struct.E.

NEW BOOKS

Analysis of Linear Systems. By DAVID CHENG. *Addison-Wesley Publishing Company Inc., Reading, Massachusetts, USA; Pergamon Press Limited, London.* (60*s*)

". . . written at the advanced undergraduate-graduate (American) level and designed for students of electrical or mechanical engineering, physics or applied mathematics." One of its main functions is to introduce the Laplace transform method of solving linear differential and integrodifferential equations.

Il Costo Delle Grandi Opere D'Ingegneria. By EUGENIO CAMPINI. *Ulrico Hoepli, Milano.* (*L* 5000)

Since economics and engineering go hand in hand, this book should be useful, providing one has lira-sterling conversion tables handy. But allowance must be made for labour costs and difference in materials. Comprehension is not made any easier by the author's adoption of a new unit which he calls the virtual cubic meter. For instance, the civil engineering work on the Panama Canal is equivalent "to 20,700,000 virtual cubic meters of simple concrete on the open sky."

TRADE PUBLICATIONS

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Construction

Hardener. METAROCK LTD., 1 Sloane Square, London, SW1. Concrete hardener for dustless industrial floors. Brief description and list of agents and installations. Brochure.

Unit Buildings. COSELEY BUILDINGS LTD., Lanesfield, Wolverhampton. Quickly erected buildings from standard components. Unlimited extension possible. Folder.

Compaction Equipment. YUBA CONSOLIDATED INDUSTRIES INC., 3201 West Mission Road, Alhambra, Cal., USA. Yuba Southwest rollers and sprinkler tanks for all road compaction work. Leaflet.

Raft Floors. STELCON (INDUSTRIAL FLOORS) LTD., Cliffords Inn, London, EC4. Raft floors and paving for hard wear. Steel clad or mineral clad. Sizes for standard and railway applications. Various leaflets.

Engineering Gelatine from Hide and Skins

Transformation from hairy hide to gelatine involves a number of well-defined processes in which the author has implemented several improvements. Among these are methods of filtering and rotary drying.

By D. G. Plowright, A.M.I.Mech.E.

In this short article the extraction of gelatine from hides and skins only will be discussed. In extraction from bones the initial processes are somewhat different but many of the operations are common to both.

The raw material can be in the form of hairy hide, fleshings, scrap cuttings from tanneries, picker scrap, etc., all of which are untanned, and by special blending extractions can also be made from chrome-tanned waste.

If very dirty the raw material undergoes a preliminary washing process. This can be carried out in tumblers or paddle washers, but it is most conveniently carried out in brick built cement-rendered circular vats some 12 ft in diameter by 4 ft high at the sides. Agitation of the material is provided by a conical wooden or metal "log" which revolves round a central pedestal in the washer. The log has fins along its length and rolls at its outer end on a ring let into the floor of the washer, so that when it is dragged through the wash water the log revolves around the central pedestal and also about its own axis. These combined motions agitate the stock very thoroughly. The washers are built in lines, the rotation of the log being obtained from an electric motor and the drive taken to the washer via a pinion and bevel wheel. The washing water enters the logwasher through pipes discharging vertically from the floor of the washer, the ends of the pipes being protected by covers against the ingress of materials.

HARDFACED KNIVES

Materials which are very large undergo a preliminary cutting operation, as also do scrap pickers. In the case of chrome-tanned material the cutting has to be extremely fine indeed. This cutting is carried out on high speed rotating cutters similar in principle to a lawn mower but with straight rotating blades chopping against a cradle of fixed knives. The knives wear and numerous materials have been tried, but the best results have been obtained with good quality mild steel blades machined away to receive a hardfacing deposited by electric welding. The material is fed into the machine by a specially designed feeder mechanism which has serrated teeth and this ensures that the cutter is fed evenly. This is most important as a high horsepower is required to drive the machines, and unless feeding is even choking can occur, the result of which is often very troublesome to clear. The presence of tramp iron is detected by means of powerful electromagnets suspended over the feed belt, or by electronic metal detection apparatus. In the case of picker waste the rivets are cut through and most of them are separated in the washing processes.

The untanned materials may now be transported to open pits where an initial soaking in weak lime solution takes place for periods varying from 4 to 12 weeks. The stock is kept agitated in the vats and this operation can conveniently be effected by compressed air applied to the vats by a lance.

After rinsing the material is conveyed back to the logwashers for a thorough washing to remove lime, and neutralising. The *p*H of the wash water, and of the raw material is tested periodically by means of a *p*H indicator covering a wide range of values.

CYLINDRICAL FILTERS

When the material is thoroughly washed and all traces of lime neutralised it is conveyed to the digesters. Often wooden pans are used open at the top, with a false bottom on which lies the material, but a more effective digester is a cylindrical vessel about 6 ft diameter by 5 ft on the straight tapering top and bottom to a central inlet and outlet. Fitting vertically in the centre of the pan is a hollow filtering cylinder wrapped around with a filtering medium. When digesting the liquor filters through both the raw material packed around the filter and also through the filter itself, and a liquor of high clarity results. The material is conveyed to the digesters either manually in skips, or it can be pumped using a pump having unchokable characteristics. When pumping a high water to flesh ratio is necessary.

Hot water is admitted to the pan via pipes which are drilled radially, and when full this is shut off and circulation commences, the liquor being pumped from the bottom of the pan by a slow speed pump through a steam heated calorifier to either one of the pipes on the inside of the pan. Reference to the diagram will make this clear.

Circulation temperatures are carefully watched for excessive temperatures spoil the quality of the gelatines. For the finest gelatines the lowest temperatures are used and for the first "run" this may be 160° F as extraction takes place easily. As circulation proceeds the concentration of the liquor increases, and when it reaches 2 to 4 per cent dependent on the quality, circulation is discontinued and the liquor is run down into weak liquor holding vats. More water is run on to the flesh and a second "run" is made at a higher temperature, again when the desired concentration is reached circulation is stopped and the liquor run down.

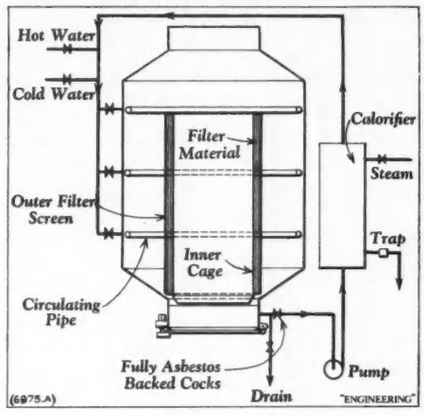
In this way successive "runs" are made, each "run" generally producing an inferior quality gelatine, this broadly speaking resulting from a change in the molecular structure of the gelatine caused by increasing temperatures and mechanical work done on the liquor.

The weak liquor vats are conveniently made of stainless steel, 18Cr-8Ni-3Mo quality being preferred, since in these vats adjustment of *p*H may be made, or the keeping properties enhanced, by the addition of sulphur dioxide. The liquor is kept warm by means of a low temperature heating coil, but mechanical agitation is not necessary.

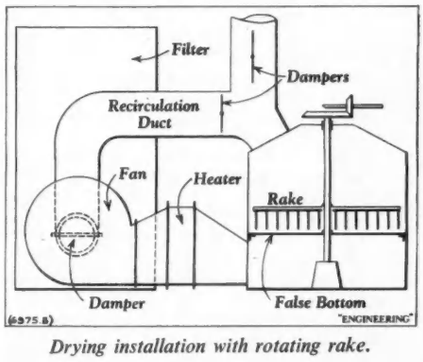
For very clear gelatines the liquor is now filtered by being pumped through a filter press using compressed paper pads as the filtering medium. The dirty pads are broken up and washed in large pulp washers a portion of new pulp being added. Final sterilisation takes place by boiling, after which the pads are repressed. When by testing the pulp is spent it is scrapped and clean pads made using only new pulp.

The weak liquor is now run down into multiple effect evaporators where it is concentrated under vacuum. The degree of concentration varies considerably for the finest qualities are but little concentrated as all evaporation has some effect on the jelly strength of the product, which loss of strength affects the commercial value of the gelatine. The evaporators familiar to the author are of the conventional multipass multitubular type with steam on the outside of the tubes and liquor on the inside; thermocompression is generally made use of between some of the effects there being four effects in all. The tubes in the evaporators under consideration were made from stainless steel expanded into header plates in the normal manner. Vacuum may be obtained by a pump, generally of the wet type or by jet condenser. During evaporation the concentration of the liquor is tested from time to time, and the flow through the evaporator adjusted accordingly.

For high quality gelatine, or where a very high degree of concentration is required, a special type of evaporator may be used. In such an evaporator it is very necessary to keep the film of gelatine very thin, and to pass it through the evaporator quickly. In one type of evaporator, the effect consists of a single steam jacketted tube about 2 ft 6 in diameter by 10 ft long. The liquor to be evaporated is fed in at the top and is thrown in a very fine film to the inner wall of the tube by means of a high speed rotor running nearly the full length of the tube; this revolves inside the tube with a very fine clearance. In this type of evaporator the vacuum used need not be as high as is commonly employed



Filtering in the digester.



Drying installation with rotating rake.

and figures of 15 in mercury are normal. The liquor is removed by means of a positive displacement pump.

Several ways exist of drying gelatine, all of which have their advantages and disadvantages. The simplest method is to run the concentrated liquor into cooling tins like a jelly mould and allow it to set. The jelly is then sliced on a machine into thin sheets of about ¼ in thickness and laid out by hand on wire nets. These are piled on top of one another on a bogie and transferred to a drying tunnel, the wettest gelatine being put in at the end remote from the fan and heater, and the bogies moved up the tunnel as dried material is taken out. This is a long and tedious process involving much handwork, and unless the tunnels are air conditioned drying is at the mercy of the weather. Additionally the cost of maintaining the nets in good condition is great, as damage is easily done to them in stripping the dried sheets of gelatine from the mesh.

It is also possible to dry the concentrated liquor by "pearling," of which two methods exist, viz., powder pearling and spirit pearling.

Continued on next page

In the former the liquor is fed to a pearl dropper which drops the liquor in the form of pearls of about $\frac{1}{16}$ in diameter on to a moving conveyor belt covered with gelatine powder of the same quality as that being dried. The belt passes through a refrigerated tunnel so that the uppermost part of the pearl which is unpowdered forms a skin, and at the end of the tunnel the pearls are separated from the powder in a high speed shaker and passed into a venturi feeder by which means they are conveyed pneumatically to the drying trays. These trays have a false bottom with the drying air passed upwards by means of fans. This system is generally only used where large quantities of gelatine of one grade are being made. In spirit pearling the liquor is dropped through a perforated plate into cold white spirit contained in a tall tower, rather on the principle on which lead shot is made. Drying takes place as previously, but obviously the method is unsatisfactory for edible gelatines and it is confined to technical qualities only.

Liquors may also be drum dried on revolving steam heated drums which is very quick but results in an extremely fine powder which is difficult for the purchaser to get into solution. For that reason this method is little used. For the same reason spray drying is not effective although it would have a great advantage in eliminating the intermediary stage of allowing the liquor to jellify.

ROTARY DRYING

The author will now describe a method of drying evolved as a result of many years of development which enables drying to be carried out quickly and in a controlled manner. Firstly the concentrated liquor has to be jelled which can conveniently be carried out on a chilled cooling drum or on a stainless steel cooling belt. Either machine produces a continuous sheet of jelly $\frac{1}{4}$ in thick by about 3 ft wide, and this is fed to a high speed cutter which produces cubes of jelly having a $\frac{1}{4}$ in side. The cubes are conveyed pneumatically to a totally enclosed drying tray 8 ft diameter having a perforated plate false bottom. The cubes are kept continually raked while drying by a rotating rake with prongs, which is driven from an overhead bevel gear drive. In practice three trays were sited in line and the rake drive to each was arranged via a dog clutch.

The drying air is taken from atmosphere *via* a filter chamber employing Vokes filter units, and is blown through a gilled tube air heater to enter the drying oven under the false bottom. As the tray is kept evenly covered by the continuous raking, air distribution is very even. The ducting allows for the air to be discharged to atmosphere or recirculated as required. Temperature and humidity control are obtained automatically, both being important, the former to prevent melting which can easily take place if too high a temperature is employed initially, the second to prevent skinning of the cubes which retards drying which in such an instance takes place by diffusion through the skin. When dry a final baking may take place which is of importance with edible gelatines as it serves to kill any harmful bacteria which may be present.

The dried cubes have now shrunk in size and are sucked out of the tray and conveyed pneumatically to a bagging-off point. The form of the dried product is satisfactory for sale, but as blending takes place very commonly to produce gelatines having desired characteristics of jelly strength and viscosity the dried cubes are generally ground in a conventional swing beater mill as made by Christy and Norris. The complete process from running liquor on to the cooling drum to bagging off the ground product may be only 4 to 6 hours.

As in all manufacturing processes for edible products scrupulous cleanliness is essential, the more so when it is realised that gelatines in the liquid or jelly state are ideal breeding grounds for bacteria. The use of stainless steel is increasing, both for apparatus and pipework. In the latter case the thin walled tubing is particularly useful in reducing initial cost. It is customary when pumping liquors to follow through each batch with steam which exhausts and thoroughly sterilises the pipe.

Antistick with Adhesives

Description: high lubricity, high heat resistance, low surface tension, non-inflammable, colourless, odourless, non-toxic, non-volatile, water-repellant, chemically inert, resistant to oxidation and breakdown.

The product answering to the above description is a silicone-based fluid called Ambersil Formula 1, made by Amber Chemical Company, Albermarle Street, London, W1. It comes in aerosol containers. Considerable savings in time are said to have been achieved in cleaning machinery and glue ducts, especially as used by printers and book-binders. Ambersil is sprayed on before use.

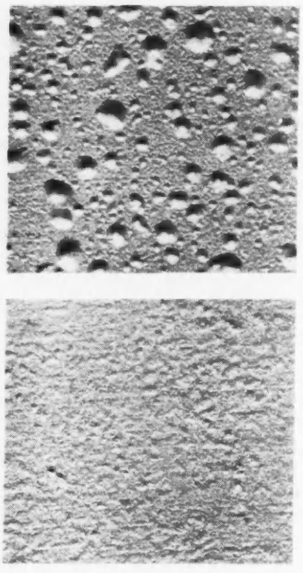
" To prevent ice formation on passenger and crew entry doors and all emergency exits " is one purpose for which Ambersil is recommended following tests by an aircraft manufacturer in cooperation with BOAC. The other use—there are two of them—is " to provide protection for dinghies, etc., before stowage on aircraft, replacing the usual French chalk." For this it is already in use on BOAC aircraft.

Phosphated Primer

It has come at last—the combination of resin primer and phosphate rust remover which works. Ever since phosphate pretreatments emerged as a method of removing rust and chemically inhibiting further attack, it has seemed a logical step to combine one of them with a resin-based undercoat. The problem, now solved by A. Sanderson and Company of Hull, was to find a resin and phosphate combination which would give good pot-life.

Kingston Kurust is being shown at the Building Exhibition, and has been subject to a patent application by Sanderson. Its effectiveness is illustrated by the two once rusty steel panels shown coated with Kurust and red lead primer after 10 days in a corrosion cabinet. Blisters belong to the red lead.

Apparently, rust up to 0·001 in can be effectively neutralised, any rust in excess of this being exceptionally thick and removable by wire brushing. One of its big advantages could prove to be its ability to dry within one hour and adhere strongly even in the presence of water. On top of this grey primer, which also



Rusty panels treated with red lead (top panel) and new primer (bottom panel) after 10 days in corrosion cabinet.

contains metallic lead, can be used any normal system of oil or metallic paints.

Adhesive Resists Immersion in Toluol

What is the advantage of resistance to toluol?—it means that the adhesive can be used in composite insulating materials which are subsequently dipped in varnishes which contain it. Bondmaster L379 is the new adhesive's name—distributed in the United Kingdom by Omni (London) Limited, 35 Dover Street, London, W1.

It is described as strong, flexible, solvent-resistant adhesive formulated for laminating Mylar (polyester film) to resin-impregnated asbestos papers, kraft and rag papers, varnished fabrics and papers, and similar electrical insulating materials. After 4 hours in toluol, L379 retains nearly all of its strength when wet and recovers all of its initial strength after drying. Dielectric strength, described as " excellent " is also retained.

Mylar-to-rag-paper laminates with the adhesive have passed Class B insulation heat-aging tests such as 96 hours at 125° C. Laminators should arm themselves with an air circulating furnace capable of retaining 200-250° F (the latter temperature for maximum bond strength in the adhesive), and nip rolls capable of being heated to above 275° F—but best near the 350° F mark.

Viscosity is 400-1,000 or 4,000-7,000 c.p.s. depending on whether the solids content is 20 or 30 per cent. Variations are also provided.

Avoid Sulphur Fumes When Burning Residual Oil

The scene is set in Paris in the Laboratoire National D'Essais; the time, July, 1959. A Babcock and Wilcox test boiler is boiling on a Redwood No. 1 heavy residual with 3·88 per cent sulphur content. Pencils hastily record the following data, to be followed by a further set when the oil is treated with 1 part in 1,000 of Desulfurol, a chemical made in the United Kingdom by Combustion Chemicals Limited, 33 Dorset Square, London, NW1.

	Fuel oil, untreated	Fuel oil, treated
Preheat temperature	198° F	167° F
Ambient temperature	92° F	85° F
Air heater outlet temperature	510° F	455° F
Steam output	1,934 lb per hr	2,067 lb per hr
CO_2 percentage	10·8	12·8
CO percentage	0·15	0·10
O_2 percentage	5	4
SO_2, average of 3 tests	4·38	3·12
SO_3, average of 3 tests	0·049 gm per cu. m gas at 0° C	0·018 gm per cu. m gas at 0° C
Flame temperature:		
30 cm from burner tip	2,444° F	2,506° F
60 cm from burner tip	2,245° F	2,390° F
100 cm from burner tip	2,120° F	2,192° F

Analysis of the data shows that sulphur oxides are largely inhibited, CO_2 and steam output are increased, and flame temperatures are higher with the additive.

Telling Astronomical Time

The first public astronomical clock to have been manufactured in London for many years was recently installed at the Financial Times offices.

It has taken Thwaites and Reed Limited, 15 Bowling Green Lane, London, EC1 (clock manufacturers since 1740) two years to manufacture the clock, which has many interesting features. The timepiece mechanism was designed by Mr. G. Buggins, F.B.H.I., and the gearing and all driving parts to the astronomical dial were designed by Mr. Peter Haward. The clock is installed at the *Financial Times* offices, Cannon Street, London, EC4 (Fig. 1).

The clock shows the time, month, day of the month, moon phase and Sign of the Zodiac. The face, about 8 ft square, is made from cast bronze, sheet copper and coloured glass and it will be illuminated from the rear. The whole mechanism is automatically electrically operated.

The timepiece mechanism (Figs. 2 and 3) is a standard Thwaites and Reed automatically wound turret clock movement, having a 6 leg gravity escapement, pendulum and 60 lb bob.

The centre or lead-off arbor has a wheel of 80 teeth which meshes with a pinion of 24 on the driving or second arbor. To this arbor is fitted a chain pinion of 15 teeth and a wheel of 90 teeth which drives the third pinion of 10. A wheel of 90 teeth on this third arbor drives the escape pinion of 9.

All arbors are pivoted in easily detachable cocks of an inverted V shape, mounted on a flat bed having raised machined surfaces on which these cocks are bolted by means of $\frac{1}{4}$ in Whitworth Allen screws. The winding motor is a Brook 1,500 r.p.m. $\frac{1}{8}$ h.p. which belt drives a 60 : 1 reduction worm gearbox on which the winding pinion of 15 teeth is fitted. The motor rewinds the weight at about 25 minute intervals and is switched into operation by a mercury limit switch mounted on a horizontal bar held in position by a hook. This hook is tripped at the bottom of the weight's descent. On rewinding, the weight raises the horizontal bar until it locates on the hook and at the same time breaks the circuit in the mercury switch. A thermal overload switch is provided as a safety precaution against overwinding.

The clock frame is finished in light green hammer stove enamel, the wheels and cocks in satin chrome plate. All pinions are case hardened and polished, the escapement and gravity arms being grained and lacquered clear.

The outside minute hand (Fig. 4) is rotated once per hour in an anti-clockwise direction and consists of a bronze ring approximately 6 ft in diameter, made from 2 in $\times$ $\frac{1}{2}$ in bronze, laid on edge. It is held in place by 12 sets of rollers, each containing three steel rollers. These are mounted in such a way that the vertical rollers roll on the bottom inside edge of a fixed iron ring mounted some 2 in behind the face of the dial, while the horizontal rollers prevent the dial from moving out of the vertical plane by coming into contact with the front or back face of the iron ring.

Fixed round the outer edge of the roller brackets is another iron ring, also approximately 6 ft in diameter, and with 450 links of $\frac{1}{2}$ in pitch chain mounted on it to form a complete circle. This chain is made up from inner links of Renold 046 chain and outer links of 046 Duplex chain which pass through the inner links and also through the iron ring. The side plate of the chain is then riveted on to the back to make a gear wheel of 450 teeth. Into this chain there is a 15 tooth chain wheel rotated at the rate of half a turn per minute (i.e., 450/15 = 30·1 ratio) in the following way: above the clock movement there is a train of wheels similar to the striking train of a normal turret clock, except that instead of a barrel there is a chain sprocket wheel mounted on an endless chain. Over this wheel is a standard automatic winding unit. The train is such that when the clock releases it by a normal type of warning and release, the stop arm is allowed to turn one complete turn. As this stop arm is in 2 : 1 ratio with the drive arbor, the drive is allowed to make a half turn. This operation occurs every 15 seconds. This method of drive is installed so that any variation of load on the dial ring has no effect on the actual timekeeping of the clock.

The hour ring must be turned round once every 12 hours and is mounted on 12 sets of rollers similar to those on the minute ring except that they run round the outside of an inner iron ring of approximately 4 ft 6 in diameter. Mounted on this ring is another drive ring composed of 360 links of chain fixed in a similar way to the minute drive.

The drive for this comes direct from the 1 r.p.h. centre arbor of the clock through a 2 : 1 ratio pair of spur gears and finally to a 15 teeth chain wheel meshing with the 360 links of chain. In one hour the 15 teeth pinion turns twice.

The month and Zodiac ring (Fig. 5) is the inner moving dial showing the proper month on the outer edge and the sign of the Zodiac on the inner edge. This dial is mounted on rollers similar to those of the hour and minute dials; they run round the inside edge of the inner iron supporting ring.

The method of turning this is by a brass ring of about 2 ft 6 in diameter with 365 ratchet teeth cut on its outer edge. Mounted on the side of this ring is another, with 12 cuts in it, the function of which is to enable a lever to drop on to it each day. When the lever falls through a cut in the ring, the date is automatically returned to show the first of the month.

The centre "Sunburst," which is fixed, has a moon phase aperture at the 2 o'clock position. It consists of a piece of opal glass across which moves a circular shutter. This consists of two circles of copper joined on their centre outer edge. The shutter is mounted on a short arbor on which is a 59 teeth wheel with ratchet shaped teeth.

The date aperture below the centre face is an opening approximately 4 in by 3 in. The date

Continued on next page

Fig. 1 The astronomical clock installed.

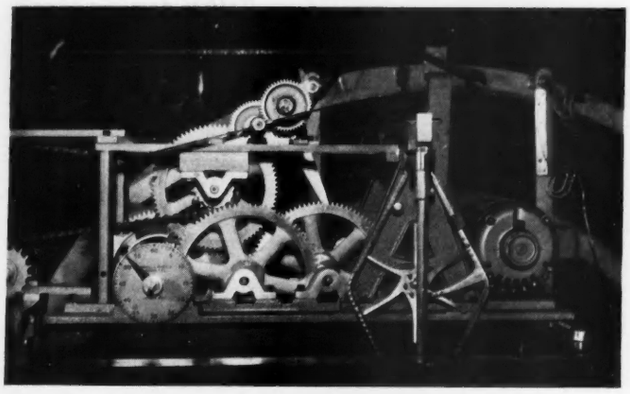
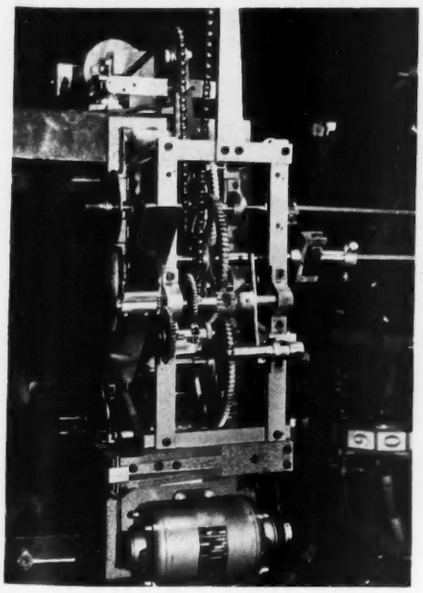
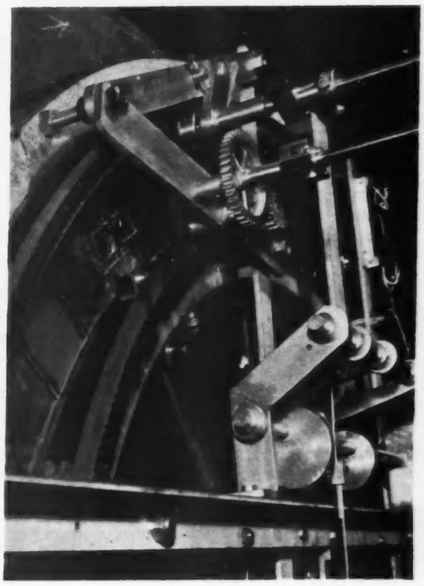


Fig. 2 (left) The timepiece mechanism is shown here and in Fig. 3 (lower left).

Fig. 4 (lower right) The outside minute hand mechanism.





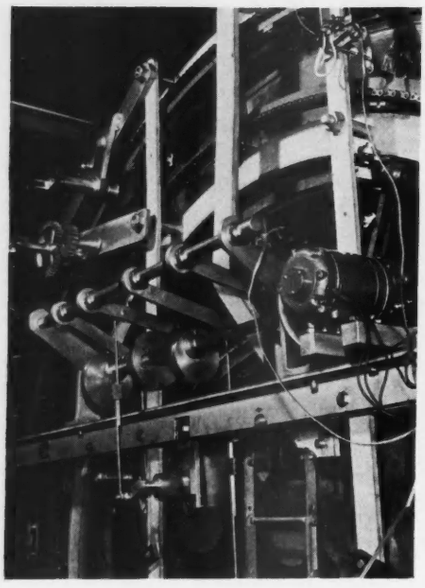


Fig. 5 Mechanisim for the ring which shows the proper month as well as the Sign of the Zodiac.

(Fig. 6) is operated by two cage-like frames in which painted white perspex numerals are fitted, 10 on the "units" plus one blank and one to three on the "tens" frame. The units are turned each day by a pawl pulling up on one of the ten studs mounted on the edge of the cage. When it gets to the "0" it turns the "tens" cage round to the next number automatically. There is also a release mechanism mounted on this which turns the "units" to 1 and the "tens" back to the blank frame.

The date, month and the moon are all operated by a small geared electric motor turning a horizontal shaft some 12 in behind the dial on which is fixed the 4 operating cams and an insulated switch plate.

The shaft turns at a speed of 1 r.p.m. and in so doing the cams operate levers up and down, the first pulling an arm which operates the month dial and advances it by one day. Another lever is then dropped onto the cut ring and should it be at the end of the last day of a month it will drop through the cut and in so doing the hook on the end of it will engage with the release mechanism on the date box. The cam is still turning and slowly releases the date to the first day. When this has happened the date advance cam operates (when the date release is operated this does nothing) and the moon is advanced one day also. The date release arm is then raised slightly higher when a small detent releases the hook, ready to advance at the next midnight.

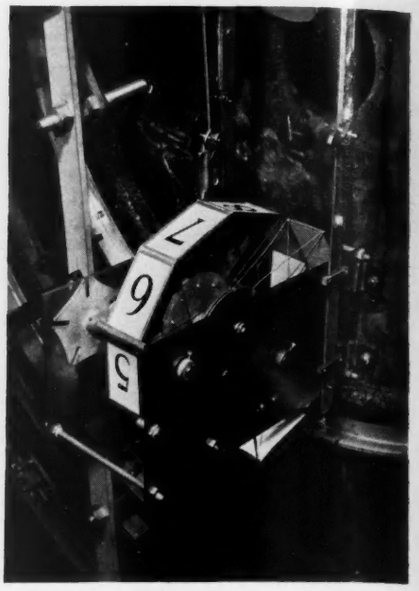


Fig. 6 The numerals are shown here on the frame in position for viewing through the date aperture

Developing a Material for Superheater Tubes

With most of its sources of hydro-electric power already exploited, Sweden is looking to the "old" fuels, oil and coal, to meet its ever-increasing demand for electricity. For instance, the largest underground steam power station in the world is under construction in the primary rock of western Sweden.

Steam power today is not the same as it was twenty years ago. Pressures and temperatures that give a much higher efficiency are employed, and the specifications of the materials used are altogether different. Around 1910, an up-to-date steam power station operated at a steam pressure of 10 to 15 atmospheres and at a temperature of 325 to 375° C. In the 1920's, operating pressures of 25 to 40 atmospheres and temperatures of 400 to 450° C were reached. Towards the end of that period, pressures had reached 100 atmospheres, while the steam temperature figures were continually moving. Since 1951, a German steam power plant has been operating with a pressure of 160 atmospheres and a steam temperature of 610° C and a number of steam power stations with similar operational data have been built in both Germany and the USA In some of these the steam temperature has, in fact, been increased to 650° C. Again, in the USA and in Germany, a few plants with supercritical pressures (i.e., pressures) above 225 atmospheres) are now in operation. The generation of steam in this type of boiler is more efficient than in a boiler working at lower pressure, and at these high steam pressures and temperatures the efficiency of the boiler and of the connected steam turbine is greatly increased.

These developments have not taken place without research and experiment, and many experimental power stations have been built. In the 1930's, the Sandvik Steel Works in Sweden supplied tubes for a boiler in Belgium to operate under supercritical conditions. The pressure in this boiler was later reduced below the critical limit (225 atmospheres) but even so they were dealing with figures that are interesting today.

At that period it was pretty clear where progress would lead but the problem was to find the proper materials; steels that would stand up to high pressures and temperatures for long periods. It was easy to evolve a suitable steel for the water-carrying tubes in the boiler itself, but real difficulties were encountered when the conventional materials were tried in the superheater. At temperatures below about 400° C, the yield point of the materials is used for estimating the wall thickness of the tubes, but at temperatures above 400° C, stresses even below the yield point can result in severe deformation of the tubes. This is due to the continuous expansion (creep) of the material. Below the critical temperature limit the expansion is elastic, but when the temperature limit is reached, a plastic deformation occurs and eventually results in rupture of the tubes. The time required for creep-rupture to take place depends on the stress built up by pressure and temperature in the tube wall.

All this shows the task that faced the research metallurgist. It meant that he must provide the boiler designer with a steel of high resistance to creep at high temperatures. The higher the temperature rise without excessive creep, the better. Experience had proved that a pure carbon steel by no means stood up to these requirements, and it was necessary to use an alloyed steel, in order to get the required creep properties.

But which was the ideal alloy? In the early stages, it was believed that an accelerated short-term test would clarify the behaviour of the steel under the existing critical conditions met in use, such as for tubes in the boiler superheaters. Preliminary experiments showed, however, that long-term tests were necessary, amounting to at least 10,000 hours and, at most, 25,000 hour for each test.

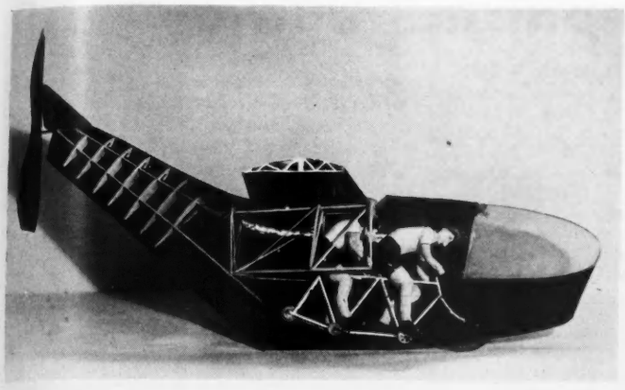
The "creep" laboratories at Sandviken where these tests were made are provided with special high-quality equipment. The instruments must be very accurate, if a constant temperature is to be applied to the test pieces for long periods. In the first place, the room temperature must be kept constant and so the testing rooms have been equipped with thermostatically controlled air conditioning. The test pieces are mounted in furnaces where the temperature is accurately controlled to a tolerance of less than 2° C. The test pieces are submitted to a constant load and a stress produced that results in continual deformation of the material. The elongation which takes place over such a short period as 24 hours is very small and consequently the demands on the sensitivity of the measuring instruments are extremely high. Often it is a question of thousandths of a millimetre, when deciding on the suitability of a material.

In order to carry out creep-testing efficiently and gather sufficient data, there must be a great number of testing units. The boiler builders demand that every steel quality be tested at three or four different loads at certain fixed temperatures between 450° and 700° C, depending on the type of steel.

Austenitic stainless steel is employed when one reaches the maximum temperature of steam at present applied, that is, 600° to 625° C, and simultaneously the highest pressures. However, this steel does not entirely solve the problem. Austenitic material is very sensitive to stress corrosion, which produces cracks in the tube wall when chlorides or alkali are present. For this reason, very close control must be exercised on the purity of the water used in boilers with tubes of the austenitic type working at these extraordinarily high pressures and temperatures. The chloride-content must be kept below one milligram per litre and the oxygen-content of the water must not reach 1/500 of a milligram per litre. As a rule it is very difficult for small boiler stations to meet these requirements. Large power stations, generally equipped with condensation plants, are in a better position to control the minute percentage of impurities in the water.

The high price of austenitic steel is another disadvantage. Efforts are therefore now being made to evolve a less expensive ferritic steel, which is not sensitive to stress corrosion. The problem that the research man is faced with in ferritic steels, however, is their very low creep strength at temperatures of 600° C and above. Summing up the task of the research people, it can be stated that the walls of the tubes in the superheaters must not be too thick, and the creep strength values of the ferritic steels at the temperatures involved must be raised. This is the problem of today and already the problem of tomorrow can be foreseen. It will perhaps be possible to arrange the transfer of energy between the reactor and the turbo-generator in the future atomic power stations to be by means of a gas medium, such as carbon dioxide. The temperature ranges will then be still higher, with an operating temperature in the 700° to 800° C range. In other words, approximately the same temperature as that of a jet engine.

As a result of the intensive research, and the careful methods of production that the Sandvik Steel Works employ, the company has an extensive manufacturing programme in this field.



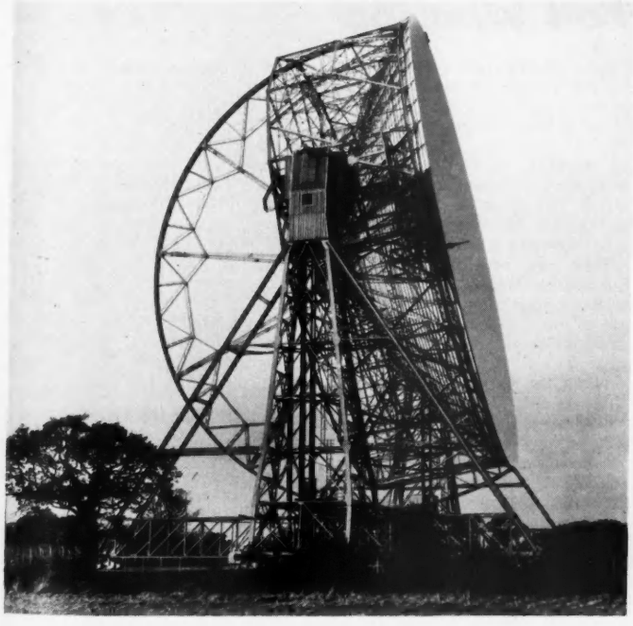
Model of the man-powered aircraft designed by T. R. F. Nonweiler, senior lecturer in aeronautical engineering at Queen's University, and his students.

(Right) Largest propeller ever cast in nickel-aluminium bronze (Lips, N.V., Holland).

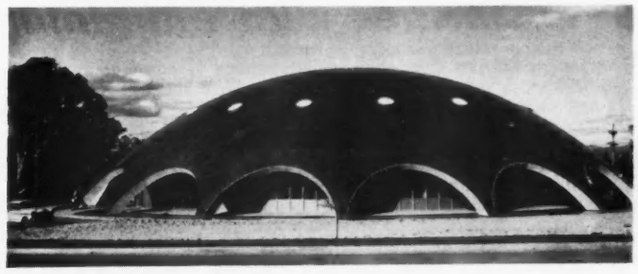
Twenty-eight fully equipped paratroops boarding the de Havilland (Canada) Caribou transport.

When this Farlander telescopic caravan trailer is unfolded, it makes up into four full-size berths.

This is one of two Chubb and Sons strongroom doors for the Bank of Montreal, the largest ever.



General view of the Jodrell Bank telescope in Cheshire. Radio signals were successfully bounced off the planet Venus recently, 30 million miles away.



The dome of this building, the Australian Academy of Science in Canberra, is of concrete covered with copper sheets. It measures 156 ft across its base.

The first radio telephone service for motorists has been started in Cheshire by the Postmaster General, and the picture shows the handset in the car.

Aluminium Lamp Standards

The results of a competition, sponsored and organised by the Aluminium Development Association, for the design of street lighting columns, have just been announced. The object of the competition was to encourage good design, taking into account aesthetic appearance, economy of construction and the advantages of aluminium.

The names of the assessors of the competition, and details of it, were given in an earlier issue (ENGINEERING, 24 April '59, p. 560).

Fig. 1.

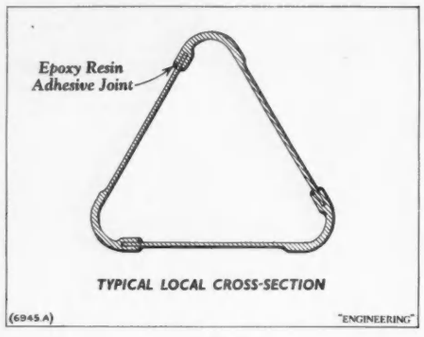
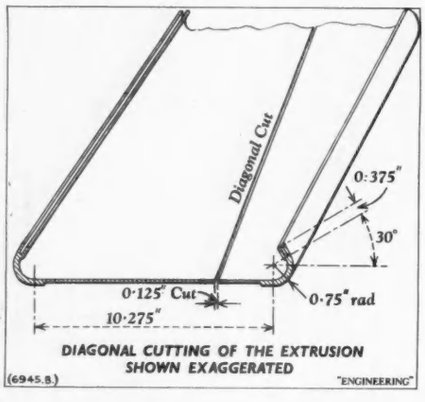


Fig. 2.



The first prize was won jointly by Mr. J. Howe, F.R.I.B.A., F.S.I.A. (design consultant to AEI Lamp and Lighting Company Limited) in conjunction with Reynolds T.I. Aluminium Limited, and Mr. J. B. Dwight, M.A., M.Sc., A.M.I.Mech.E. (member of the Civil Engineering Department, University of Birmingham).

The winning design was for both 15 ft and 25 ft columns. In each case the column is vertical and has a tapered triangular cross section (Fig. 1). The shaft is fabricated from HE9-WP channel extrusions with 60° inclined flanges (see Fig. 2). The edges of the flanges are slotted, and each extrusion is cut diagonally from one end to the other. This cuts each extrusion into two pieces and three extrusions cut into six pieces rather cleverly enable two columns to be made.

Fabrication is simply done by interlocking the cut extrusions together. The finished column is shown on the right (Fig. 3).

The taper in the column is made possible by the diagonal cut and results from the assembly of three sections with their wider ends together. Mechanical strength is obtained by using an epoxy-resin adhesive of the cold setting type to bond the joint between the slotted flange of the extrusion and the inserted taper-cut part of the web.

In the 25 ft column, the method of construction described enables the column to be made in one piece approximately 28 ft 6 in long from spigot to base plate. In the 15 ft column the construction is in two parts; the tapered part terminates at about 3 ft above the ground. The base of the tapered section is bonded to a die-cast base cap. Below the base cap the triangular cross section is maintained in a parallel sided gear chamber pressed from NS4-$\frac{1}{4}$H sheet with an interlocking flanged sheet to complete the third side of the triangle. The inter-lock is, in effect, a folded joint obtained by sliding the two sheet members of the base together. The gear chamber door in the 15 ft column is formed from one part of the inter-locked sheet by eliminating the inter-locking edge flange previously mentioned.

On the 25 ft column the gear chamber door projects slightly and increases the overall cross section dimensions. It is fabricated from sheet material with the corners welded to form a rigid tray-like component. The door tapers both in front and side elevations.

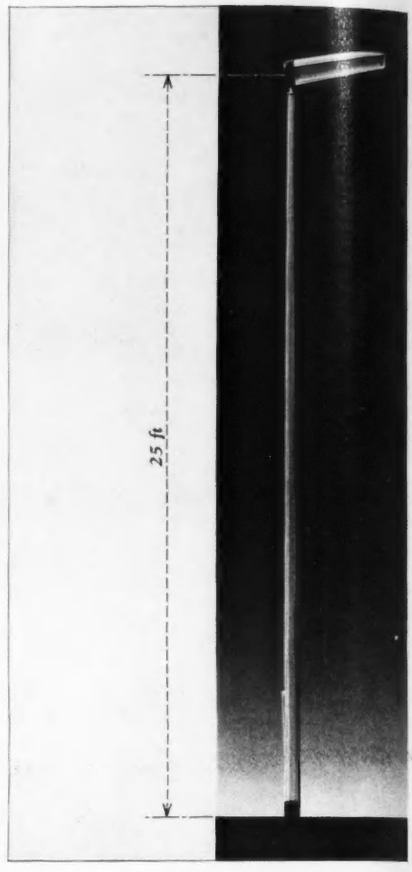


Fig. 3 Model of the winning 25 ft column.

Apart from the fabrication of the gear chamber door, welding is used to secure reinforcing tubes on each side of the gear chamber door opening, in the construction of the 25 ft column; and in the connection between the base section and the cast base cap, on the 15 ft column.

Transformer with Aluminium Foil Winding

The Balarc 175, an aluminium-wound welding transformer, is the result of imaginative design throughout, using up-to-date materials and techniques. The choice of Noral aluminium strip for the transformer windings was fundamental to the design for though still far from conventional, aluminium strip windings have been well tested in other fields, and offer several advantages. For instance, aluminium weighs less than one-third copper, and although a somewhat greater volume of metal is needed (because of the lower conductivity of aluminium) the use of this material has saved weight and resulted in a highly portable outfit. Despite this slight increase in the volume of metal, the windings are actually more compact than conventional ones would be. There are several reasons for this: (*a*) The aluminium strip is insulated by anodising, the process that thickens the natural film of oxide on the metal. This film is an effective electrical insulator, but it takes up much less space than conventional interleaving material; (*b*) the aluminium strip is as wide as the winding, and the edges of each turn are therefore in direct contact with the cooling air. This, and the fact that the anodic insulation is completely unaffected by temperature, means that more can be got out of a given size of winding; (*c*) the coiled strip design eliminates the thousands of 'voids' inevitable with coils of round wire, and again saves space.

Aluminium is not only a good electrical conductor but a cheap one. The price of aluminium is, moreover, remarkable for its stability, so that the price of the transformer is not liable to violent fluctuation.

In the development of the windings, Ashton-Young Engineering Development Company Limited, 76 Cambridge Road, Kingston on Thames, Surrey, had the cooperation of Aluminium Laboratories Limited and Northern Aluminium Company Limited. Both are member companies of Aluminium Limited of Canada, a group with over 50 years experience of the electrical industry in all parts of the world, and with unsurpassed research and development facilities.

Assembly is to be undertaken by Remploy Limited, at whose Bermondsey factory a team of men handicapped by chest ailments has been specially trained for this highly skilled operation. This factory, once engaged on woodworking, has been changed over to electrical equipment assembly work in recent months and special plant installed.

Remploy Limited is, of course, the national organisation employing the severely disabled. It has 90 factories in England, Scotland and Wales providing productive employment for about 6,200 seriously handicapped people, of whom just under 3,000 are ex-service men and women. However, the company has never tried to sell its goods or services on sentiment. Prices and quality are equal to those of open industry.

The Balarc 175, which meets the specifications of many countries (including the UK, USA and Germany) is ideal for continuous operation in high ambient temperatures and adverse climatic conditions, each unit being chemically treated to prevent moisture or foreign bodies getting in.

The transformer can be used on any two phases of a three phase supply or between one phase and neutral or on single phase. The maximum welding current is 180 amp, the minimum 25 amp and the continuous hand welding current 175 amp kVA at BSS rating 8 kVA. It can weld from 8 s.w.g. to 16 s.w.g. Dual voltage control gives a high volt range of 25 to 135 amp and a low volt range of 45 to 165 amp.

MOLLIER DIAGRAMS

We regret that in publishing the article " Another Use for Mollier Diagrams " in our issue of 18 September, page 214, the names of the authors were omitted. The authors are Carl H. Builder and Gilbert S. Bahn, respectively Research Engineer and Technical Coordinator at Air Space Travel Research Organisation (ASTRO), the Marquardt Corporation, 16555 Saticoy Street, Van Nuys, California. The article was a digest of a longer paper (entitled " On Mollier Diagrams for Combustion Gases "), as explained in a footnote to the digest.

Omnivorous Engines Simplify Fuel Supply

Fundamentally, the compression ignition engine is capable of running on a wide range of fuels, and it has been developed to do so for military purposes. Considerable commercial possibilities are inherent in such an engine.

Because a diesel engine has a greatly improved fuel consumption compared with that of the current spark ignition engine, it is attractive from the military point of view as well as the civilian. It reduces drastically the amount of fuel which has to be transported and distributed to units in the field. Circumstances can arise, however, where there may be difficulties in obtaining the necessary quantities of diesel fuel, although petrol or gas-turbine fuel may be available. Thus, from logistic considerations, the ideal engine is one which will burn any of these fuels with comparable efficiency. Such an engine has now been developed.

In meeting military needs, the designers have also opened up a considerable commercial field, especially if the long-term view is taken. Because the diesel engine is so popular, the demand for diesel fuel is outstripping the supply in some parts of the world. Producing more diesel fuel to meet the demand brings its own problems. Only a fixed amount of diesel fuel can be obtained from each unit of crude oil; petrol is produced at the same time, and there is thus a surplus of this latter fuel. In Great Britain, a solution to the taxation problem would have to be found before multi-fuel engines could dispose of the petrol surplus, but the technical difficulties have been overcome.

The Fighting Vehicles Research and Development Establishment, Chertsey, Surrey, has been investigating the problem of the multi-fuel engine over the past six years, and at a recent symposium held there, several engines of this type were demonstrated, both on the test bed and installed in vehicles.

DESIGN PROBLEMS

An engine designed to meet the requirements of the British War Office has to be capable of operating on any fuel ranging from diesel and aviation gas-turbine fuel to a 50/50 mixture of 74 octane petrol and diesel fuel, 74 octane petrol alone, or 80 octane petrol alone. It is also desirable that it should burn civilian premium grade petrol.

In compression ignition engines, the combustion of the fuel must not be too violent or high bearing loads and much noise result. There is a delay period between the introduction of the fuel and its ignition and the shorter this is the less violent is the combustion as the fuel will burn as soon as it is injected. The combustion characteristics of diesel fuel are opposed to those of petrol since the octane rating is a measure of resistance to spontaneous combustion, the cause of detonation in the spark ignition engine. Thus a high octane rating implies a low cetane value and a long delay period.

A spark ignition engine requires a fuel of high volatility and high octane value, and will not operate satisfactorily on the low octane, low volatility fuel of the normal compression ignition engine; it cannot, therefore, be the basis of a multi-fuel design. On the other hand, the compression ignition engine will accept the lighter fuels, provided that means are adopted for overcoming the difficulty of obtaining satisfactory ignition. It is the compression ignition engine, therefore, which is the basis of the multi-fuel design which has been developed and tested successfully.

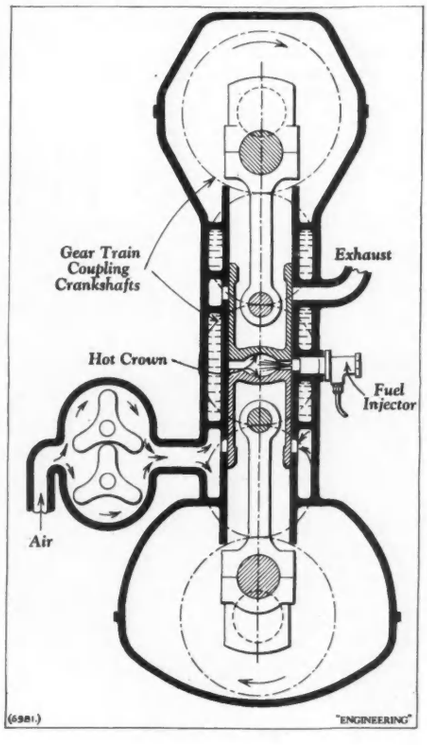
To meet military needs the FVRDE has to consider two basic types of engine. There is the special engine of high specific power output and small size and weight suitable for use in fighting vehicles, and the engine in which size and weight are not of paramount importance; this type is installed in load-carrying vehicles, where low first cost is a major consideration. Accordingly, a range of opposed-piston two-stroke engines was designed to meet the specialised military needs, and commercial engines were developed to cater for normal load-carrying vehicle installations. At the same time, the question of modifying commercial four-stroke diesel engines to operate on the specified range of fuel was investigated. All three lines of development have shown satisfactory results.

Experiments have determined that the two-stroke opposed-piston engine is the ideal basis for a multi-fuel design. In principle, this engine has been known, and in the heavier ranges as for ship propulsion, has been made and used successfully for a long time. As a smaller engine, however, suitable for installation in vehicles, it is of much more recent development, though of course the Rootes opposed-piston diesel engine has been in use for five years, and many thousands are giving satisfactory service.

For specialised military use, three groups of engines have been developed, all of basically similar design, with opposed pistons and two crankshafts, connected by a train of gears. This gear train is particularly useful, as power is taken off one of the idlers in the train, and by adjusting the gear design, the output can be arranged at the most convenient height, speed and torque. All the engines in the range operate on the two-stroke cycle, with one piston controlling the inlet ports and the other the exhaust ports. The piston crowns are made of heat resisting steel, with narrow heat conducting paths to the piston skirt. This results in a very hot combustion space, which is one of the principal reasons for the success of the engine.

The largest of the engine groups, the "L" series, is at present a six-cylinder type, though as with the other groups, alternative numbers of cylinders are envisaged. Developed by Leyland Motors Limited for the FVRDE, the L series will develop 700 b.h.p. at a crankshaft speed of 2,400 r.p.m. and an output shaft speed of 2,670 r.p.m. Intermediate in size, the "K" series, developed by Rolls-Royce Limited, is a five-cylinder engine, giving 200 b.h.p. at a crankshaft speed of 2,400 r.p.m. and an output shaft speed of 3,750 r.p.m. The smallest in the range, the "H" series, produced by Coventry Climax Engines Limited, develops 30 b.h.p. at 3,000 r.p.m. It is a three-cylinder unit intended (for military purposes) as an auxiliary engine to be installed in a fighting vehicle, for which the main propulsion power is provided by a larger engine from the group. It drives a 10 kW d.c. generator, and a hydraulic pump; the latter can be used for starting the main engine through a hydraulic motor when required.

All the basic features of the successful multi-fuel engine are shown in this diagram of an opposed-piston two-stroke design.



ADVANTAGES

All the military engines in the specialised range have certain advantages in common, which are of considerable commercial interest as well as serving military needs. They have a remarkable size to weight ratio; the L60, for example, has a specific weight of only 4·2 lb per b.h.p., even when the block is of cast iron. They have a very low figure of heat rejection to coolant, and an exhaust temperature of about 400° C. In addition, of course, the engines are inherently balanced and have even firing.

The bearing loads are reasonable and the big ends can be full width, which is not necessarily the case in V engines with side by side big ends. There are few moving parts, and the absence of all valve gear and camshaft drives is important as also is the absence of a cylinder head joint which can be troublesome in engines with high cylinder pressures. From an installation point of view the form of construction is an advantage and leaves ample space for auxiliaries and the free flow of cooling air. All the engines are conservatorily rated and have definite development potential. In particular the H30 could be very considerably up-rated for automotive applications.

As in any engineering development, there are certain disadvantages, but they are not of great significance. The remarkable performance of the engine demands that a large volume of air be passed through the cylinders during the scavenge period, and this entails the provision of air cleaners and an exhaust system larger than usual; these items can be accommodated without much difficulty.

In the fuel supply and injection system, further problems arise, which again have been overcome. When the engine is running on petrol, the lack of lubricating qualities of this fuel, and its tendency to cause vapour lock would give rise to difficulty if they were not taken into account in the design of the fuel equipment. In addition, since adjustments to the engine itself to suit individual fuels are obviously impossible while in service, the fuel injection equipment must be capable of such adjustments as may be necessary, and the adjustments must be few in number and as far as possible, foolproof. CAV Limited have investigated the problems associated with multi-fuel injection, and have produced a fuel pump in which all the problems have been overcome satisfactorily.

COMMERCIAL ENGINES

In addition to the military range developed by the FVRDE, standard compression ignition engines have been modified by Weslake and Company Limited for multi-fuel operation, and numerous engine manufacturers have produced their own modified designs. AEC, Austin, Bedford, Commer, Foden, Rolls-Royce, Rover and Thorneycroft have all produced multi-fuel engines, which are operating at FVRDE, and every type of road vehicle from a ½ ton Landrover to heavy lorries and tractors has been run with engines of this type.

Better Welding Techniques

The welding industry has been very active of late, producing new methods and machines. Four interesting methods are noted here, all of which can make a contribution to improved and simpler production.

Welding Thin Material

A new welding method, called Short-Arc welding, has been introduced by the Linde Department of the Union Carbide International Company, New York. It is reported to permit manual and mechanised welding of thin material with excellent control of the weld puddle. It is claimed that this new inert-gas consumable-electrode process can make manual fusion welds in the range of thicknesses of 0·030 in to 0·100 in for all common metals.

The success of this method of welding hinges on the development of several key factors: the power source, selection of shielding gas, and apparatus for feeding small wires.

So far as power supplies are concerned, the conventional type for fusion welding operations, which use either covered electrodes or inert-gas shielded processes, give too much heat to permit controlled melting when making butt, lap, or fillet welds in thin gauge material. Short-Arc welding has been made possible by the use of constant potential power supplies incorporating a " drooping characteristic."

With the development of this type of power supply, it was found that surge currents could be controlled to limit the time duration of arc outages, prevent wire ejection, and produce a stable arc. The arc, operating at currents between 30 and 125A, short circuits many times a second. This produces a small rapidly solidifying puddle and thus pinpoints where the arc is going. In the main, 0·030 in wire is used, although 0·020 in wire can be used for the very thin plates which this process can weld.

Considerable study was made by Union Carbide of the shielding gases in order to select the best gas or combination of gases for each metal. Argon was found to be suitable for most metals including aluminium and copper. For stainless steel and carbon steel, argon-oxygen and argon-carbon dioxide mixtures have proved successful. Pure carbon dioxide is being used for some steel applications, but it produces more spatter and poor bead formation. The use of argon-carbon dioxide mixtures provides major advantages over either pure argon or pure carbon dioxide when used with carbon steel. Superior wetting action is given with the minimum amount of deposited metal resulting in a vastly improved bead contour.

It is reported by Union Carbide that they have successfully developed both the mechanical and manual equipment necessary to feed wires as small as 0·020 in in diameter.

Welding Not So Thin Material

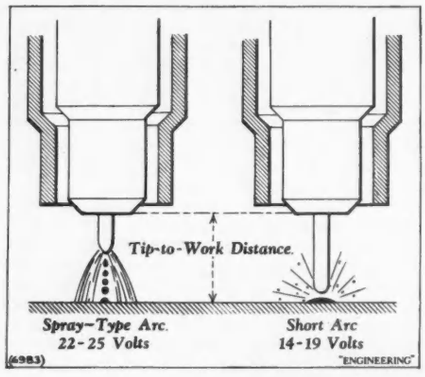
Quasi-Arc Limited of Bilston, Staffordshire, are also employing the Short-Arc technique in their Sigmette equipment. It is designed for the rapid semi-automatic welding of ferrous and non-ferrous materials in gauge thicknesses down to 16 s.w.g. (0·064 in). It also allows welding to be carried out in every position, including vertically and overhead, using a portable lightweight welding gun. The equipment is based on the Sigma process, using a continuous coil of bare wire electrode and shielded by argon or carbon dioxide.

The Sigmette welding gun weighs only 3 lb 1 oz, and a spool of wire carried with the gun can take either 1 lb of aluminium or 2½ lb of ferrous wire. The spool of wire permits up to three quarters of an hour continuous welding without reloading. The wire is positioned initially by an inching button in the base of the handle. Pulling the trigger starts the gas flow and initiates a slow wire feed. As soon as the arc strikes, the full wire speed comes into operation. The gun handles three sizes of wire, being continuously rated at 125A for 0·030 in wire and at 200A for $\frac{3}{64}$ and $\frac{1}{16}$ in wires.

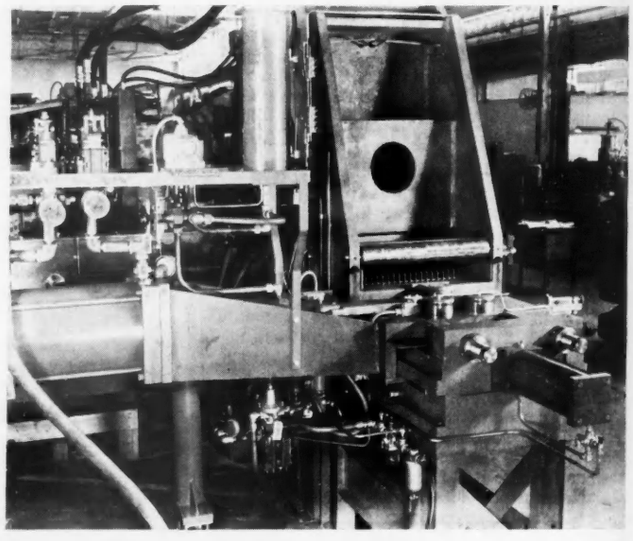
The voltage control unit regulates all the welding variables including wire feed speed and gas flow, and once these are set they are brought into operation by the trigger control on the welding gun. Standard 30 ft leads between the control and the gun allow a wide radius of operation without moving the equipment.

Direct current power sources of either the motor generator or the rectifier type can be used with this equipment, although a lightweight motor generator set, the Quasi-Arc MFB 225, is recommended. This machine has an output current range of 20 to 225 A at between 45 and 60 open circuit volts.

It is reported that this equipment is being tried on thinner material than the 16 s.w.g. mentioned in the opening paragraph.

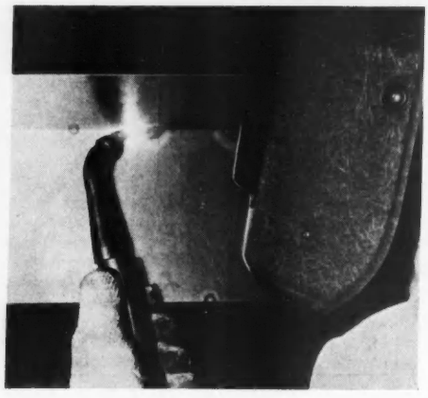


(Above) The method of metal transfer under normal arc conditions is contrasted with the " Short-Arc " method.



(Right) A Sciaky flash butt-welding machine, sometimes called a skelp welder.

(Below) 16 s.w.g. carbon steel being " Short-Arc " welded at 18 in per minute in the overhead position.



Flash-Butt Welding

A flash-butt welder can be used in various mill and process operations. Its most common application is in association with plating, pickling, stamping, forming and other operations where a continuous feed of stock is essential. In such cases, the equipment is often used in conjunction with looping pits which take up slack during a weld interval when the material is being continuously processed ahead of the pit. A weld made in this way is normally as strong as the parent metal, though in thick material normalising is usually necessary to overcome brittleness.

The BPW 3-400 H, made by Sciaky Electric Welding Machines Limited, Slough, is designed for flash butt welding hot rolled low carbon steel ranging from 0·060 in to 0·200 in in thickness and from 12 in to 22 in in width. Alternatively, it can be used on mild steel of up to 4·5 sq. in cross sectional area, or on stainless steel of up to 2·6 sq. in cross sectional area. The upset force (the force which forges the two sections to be welded together) is adjustable up to 90,000 lb, while the clamping force is adjustable up to 135,000 lb (the clamping force holds the material in the machine). The welding current comes from an air cooled transformer rated at 400 kVA at a 50 per cent duty cycle. Heat control and post heat are provided.

Facing the machine, the strip movement is from left to right. The outgoing strip is located against a positioning or gauging bar in the initial die spacing, and the right hand platen positioning cylinders properly locate the edge of the strip. The right clamp is then operated. The incoming strip is located against the gauging bar and the edge aligned similarly to that of the right platen, and then clamped.

After both sides have been clamped, the gauging bar is retracted from between the ends of the strips by means of a hand operated push button. Another push button starts the welding operation. The flashing cam advances the left hand platen rapidly to close the gap between the strip ends and then starts the flashing action. During the flashing time a high current at low voltage causes the strip ends to glow and reach the plastic state. The upsetting action then takes control and fuses the ends together. The limit switch which initiates the upsetting action also operates the upset-current timer which controls the duration of the upset current flow.

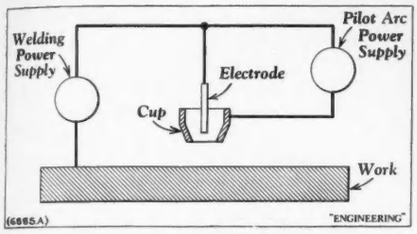
Continued at foot of next page

Production

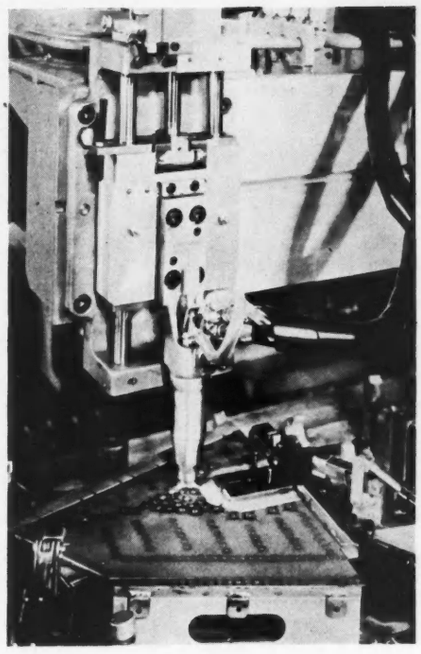
Aid to Arc Starting

The Union Carbide International Company of New York have recently introduced a development which they call Pilot Arc. This is claimed to give a positive start to Heliarc (inert-gas tungsten-arc) spot welding and cutting after a very brief delay. It is reported to be particularly useful in mechanised installations where torches must be fired according to a schedule.

Up till now, high frequency current has been the accepted method of arc starting for Heliarc spotwelding. This, however, involves the user in several difficulties, the most noticeable of which is the erratic firing from cold electrodes. The torch was warmed up by making a number of spot welds on scrap before welding the workpiece. Pilot Arc starting is claimed to eliminate all high frequency interference and also to avoid



A diagram showing the connection for the power supply of the Pilot Arc maintained between the electrode and torch cup.



Positive starting for this tape controlled Heliarc spot welding machine is claimed with Pilot Arc.

the contamination problems of retract starting. Electrode life is reported to be improved by a factor of four over high frequency starting, and process reliability is greatly increased.

The Pilot Arc acts in much the same way as the pilot light in a gas stove. It keeps a ball of incandescent gas at the end of the electrode so that the arc is always ready to fire as soon as a potential is applied between the torch and the workpiece. The ball of gas is maintained by means of a current of about 5 A from a special circuit separate from the welding supply. A small quantity of shielding gas flows continuously and protects the electrode while the pilot is on.

The operation of the Pilot Arc is very simple. The torch is lit at the start of the shift using a tungsten rod to make contact between the tungsten electrode and the cup. The torch remains alight throughout the working day, and is thus always hot and ready to fire.

Sorting Sheet Automatically

The capacities of rolling mills and tinning plants are becoming so great nowadays that things are tending to get out of hand on the finishing line. There are cases reported where the equipment is no longer able to cope with either the amount or the variety of the output. Because of this, Schloemann Aktiengeselschaft, Düsseldorf, have developed a high-speed fully-automatic plant for sorting and stacking sheets.

When the strip enters the plant, it is cut into sheets which are transferred by conveyor belt to a sorting belt. Faulty sheets are thrown off a tone or two sorting stations, depending on the type of defect. Satisfactory sheets proceed to the end of the sorting belt. A fully automatic sorting and stacking plant of this kind, for dealing with electrolytically tinned sheet in lengths of 14 in to 59 in, has been supplied by the makers for use in a mill operating at 1,300 ft per min.

Concluding Better Welding

The change from the flashing current to the upsetting current is carried out without a break.

After upsetting and a holding period which can be adjusted, the clamps are released and a set of lift rollers raises the strip above the level of the lower dies. The platen returns to its initial position, and the welded strip passes through the machine to a plough shear which removes the flash particles. A push button initiates the gauging bar, and brings it into position ready for the next weld.

Submerged Arc

Rockweld Limited recently announced the development of automatic equipment operating the submerged arc process, which they have named Autopak. In the submerged arc process, the welding head feeds copper coated wire to the arc, which takes place under a blanket of flux fed from a hopper on the head.

This method of welding is said to have several advantages over conventional methods of welding. Because of the higher permissible currents compared with hand welding, the rate at which weld metal can be deposited is considerably increased, but the nature of the process is such that the majority of welds must take place in the downhand or horizontal-vertical position. As an example of the speed which can be obtained with this method, it is claimed that butt welds on 12 gauge plate can be made at speeds up to 100 in per minute.

Another advantage of the submerged arc process is that its use leads to improved shop conditions over those associated with other methods. This is because arc rays, fumes, spatter and radiated heat are eliminated. With the disappearance of these sources of discomfort and hazard to the operator it is reasonable to expect an increase in efficiency.

The welds produced by this method are reported to be of outstanding quality and are approved by Lloyd's Register of Shipping. It would seem that this equipment will lend itself to completely automatic operation.

Marketing

Release for Husbands

Washing up machines are well known, at least in advertisements, but it took Sir Charles Colston, former chairman and managing director of Hoover Limited, to think up a dish-washing machine that can be fitted on to a trolley, wheeled into the dining room, filled with the dishes, and wheeled back to the sink to perform its chores.

Charles Colston Limited, which is also active in oil heaters and makes the Commando grade rubber soles for heavy duty boots, is at present engaged in building up stocks to the point where sales can begin of what is claimed as the first dish washer that is all made in Britain. Modern stoves, refrigerators and washing machines have about filled the space in contemporary kitchens. The " Colston " dish washer has been designed to stand on the draining board. It measures 17 in deep, 21 in wide and 24 in high.

Safety features play an important part in the quality of kitchen fittings since a child-harassed housewife cannot be expected to remember an infinite number of Don'ts. In this machine the principal safety device is that the machine switches itself off if the door is opened during use. A familiar function of the washing machine has also been adopted in that if there is not enough water the heater switches off.

On the face of it—quite apart from being a labour saver—such a machine must go some way towards paying for itself in reduced china and glass breakings.

Himalayas and Helicopters

India, with its hills and mountains, and not being overburdened with civil engineers, has an infrequency of aerodromes that makes sense of a policy of going in for helicopters.

This the Indian defence ministry is showing signs of doing, and Westland Aircraft, of Yeovil. are quick off the mark to do something about it, A Westland technical sales team, led by Leonard Thornhill, himself a helicopter pilot, and including the company's chief designer, P. E. Q. Shunker, is about to leave for India. The sales mission, a joint Saunders-Roe and Westland undertaking, will be armed with the facts and figures on the four turbine-engined helicopters already flying. Westland believe that there is a special value to be got out of the turbine-engined helicopter in its suitability to use at high altitudes. The Westland P 531 is capable of taking off from heights of 14,000 ft and carry useful loads up to 20,000 ft.

The Westland Wessex, the second of the company's helicopters they think the Indians may be particularly interested in, can lift cargoes of over 4,000 lb or 18 equipped troops. The Wessex has the unusual capacity, of obvious significance in terms of military use, of being able to take off within 30 sec of starting from " cold."

Bridge Team

The city of Perth, Western Australia, is growing fast. So is its motor traffic, which now stands at one car for every 4·9 persons. As the new residential areas are on the south side of the Swan River, a new bridge was required to connect the old and new parts of the city.

Accordingly, in 1955, the then bridge engineer of the main roads department, Mr. E. W. Godfree, was sent to Europe to discuss the problem with leading bridge designers and to select a firm of consulting engineers to design and supervise the construction of the bridge, which had to cross the river at a point where it is 700 ft wide.

On his recommendation, G. Maunsell and Partners, of London, were appointed consulting

Marketing

engineers because they were able to offer a team of engineers and architects to tackle the work, Led by Mr. G. A. Maunsell, the senior partner, the team also included William Holford and Partners as architects, Mr. E. W. H. Gifford as specialist consultant for the prestressed concrete deck, and Mr. C. S. Chettoe, formerly bridge engineer to the Ministry of Transport in London. The final result—one of the most interesting bridges yet built—was described and illustrated in last week's ENGINEERING (p. 506).

Uddeholms in Britain

Competition from Swedish steel in this country has been almost unfelt since before the war, but the increasingly tough marketing conditions which most producers are beginning to experience suggests that this may not be so for very much longer. One of the largest, and oldest established of Sweden's steel making concerns, Uddeholms Aktienbolag, have recently strengthened their representation in this country. Their subsidiary company, Uddeholms Limited, of Crown Works, Birmingham, have expanded their activities and appointed a new midland area manager, Mr. A. G. Shaw, who was formerly their representative in Birmingham. Mr. Shaw will be responsible for the sale and service of the tool steel and heat treatment divisions of the company.

Uddeholms AB are a large concern operating in the iron, steel, chemical and forestry industries. They own mines in central Sweden which are said to be among the best equipped and most efficient in the world. They yield iron ore of exceptional purity as well as other products such as manganese, wolfram, limestone and dolomite and many others. The company operate a sponge iron plant, steel works and hot rolling mills, cold rolling mills and tubes. They specialise in the production of high duty steels for rock drills and tools, razor blades, bandsaws and a range of tungsten carbide, stainless sheet and strip, stainless tube and silver steel

They have their own hydro-electric system and operate more than 30 stations with a combined capacity of over 1,000 million kWh perannum. The British company was founded some 30 years ago and is one of a large number of subsidiaries covering the whole non-communist world.

Holman's in Birmingham

New premises to house a large selling and servicing organisation have been opened by Holman Brothers Limited, Camborne, which will be the Midlands headquarters of all the subsidiary companies of the Holman group—Climax Rock Drill and Engineering, Maxam Power, Goodyear Pumps, and Dustructor Company.

Holman, who are the Commonwealth's largest manufacturers of compressed air equipment, have been active in the Midlands for over 70 years with a large head office in Sheffield and sub-offices in a number of other centres. The decision to operate from new and larger premises in Birmingham has resulted from the rapidly expanding Holman and Climax business in this area and the increased demand for Maxam pneumatic control equipment and Goodyear pumps—both recent group developments.

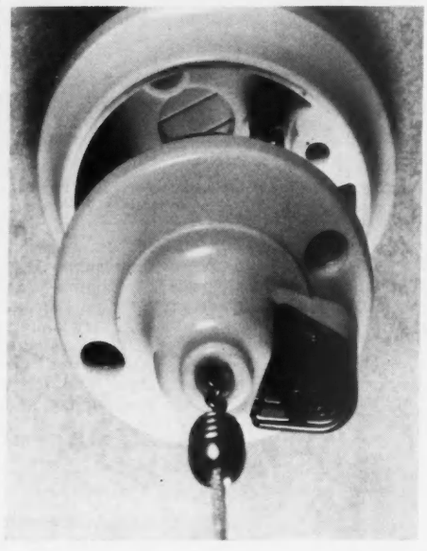
At Home

Switch Safely

There was once a small boy. He had some lead soldiers of which he was very fond but one of them had lost its stand. Seeing the two separate legs the boy was seized with an idea—he went over to the electric socket in the wall and pushed the legs into the holes. They fitted exactly and he switched on . . .

That small boy is still alive today. He was doubly lucky; first because he let go the soldier before he switched on and secondly because the socket he chose had a switch. He was unlucky however because the socket he chose was not one that had shuttered openings. In fairness it must be added that this happened some time ago when sockets of that type were not as generally available as now. It is interesting to note that in one current catalogue no other type of three-pin socket is listed.

There can be few houses as yet where the suggestion that there should be six to ten sockets in each living room and three to five in each single bedroom has been followed. In general though, the newer the house the more outlets there are, especially where the ring circuit system of wiring has been adopted. Trailing leads are always a danger.



The ordinary plug and socket is not intended to be used to break currents. Whenever therefore an appliance has no separate switch of its own, a switched socket should be used. Since it can be argued that any appliance can be used in any socket (providing the loadings agree) there is a case for having all sockets fitted with switches, though this would be expensive. Shuttered sockets have plates which blank off the live holes when the plug is withdrawn, and which are moved clear by the end of the earth pin as it enters the earth hole when the plug is pushed in. The case for shuttered sockets has already been made.

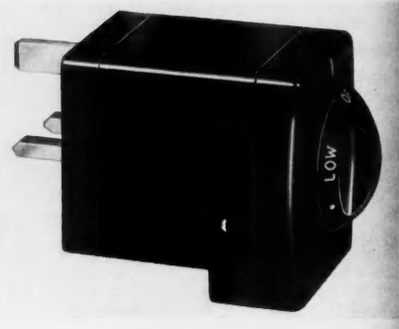
There have been many fatal accidents in bathrooms caused by touching electric fires or even light switches with wet hands. Heaters must be mounted out of reach and to control them cord switches are best used. A new one is the MK model (illustrated) which is fitted with a pilot light to show when it is on. It is also available without the light. The model shown has a double-pole action and is rated for 15A.

Regulations forbid any socket outlets in a bathroom and therefore the use of any loose appliance, though an amendment has been made to allow the use of electric dry shavers but only under close control. A shaver must be plugged into a socket unit in the wall and the socket must be out of reach of anyone in a bath. The socket contains a transformer that isolates the shaver circuit from the mains supply and has full earthing arrangements.

The ring circuit system has several sockets in parallel protected by a single fuse or by a miniature circuit breaker. Each plug feeding an appliance has its own fuse so that individual protection is given. Advantages include better protection for smaller apparatus and the fact that failure of one item does not affect all the others on the circuit. Using a miniature breaker for the main switch also simplifies supply control. Apart from safety, the system has the advantage that it is usually cheaper to install than the conventional supply wires to individual outlets. Appliances that are fixtures—like built-in electric fires—are connected to the ring by fused spur boxes.

A great many appliances are not fitted with any means of regulation other than an on/off switch. There are occasions however when full heat is not needed, and for these Sunvic have produced the Reguplug, a simple unit that will fit into any 15 or 13 A socket and will regulate the supply from zero to full. It works on the Simmerstat principle that has been in eus for some years to control electric cookers. The Reguplug fits on the lead from the appliance, and the 13A model includes a fuse.

(*Left*) *Bathroom heaters can be safely controlled by ceiling-mounted switches that are cord operated. The one here has a pilot light.*



(*Above*) *For electric appliances that have no built-in regulators, the Reguplug unit, which permits a variable load to be taken, can be fitted into the socket. The 13A model illustrated includes a fuse.*

ENGINEERING

Published every Friday by ENGINEERING LTD. at 36 Bedford Street, London, WC2.
Telephone: Temple Bar 3663.
Telegrams: Engineering Lesquare London.

CHAIRMAN: J. A. Dixon, M.A., A.M.I.Mech.E.
EDITOR: F. B. Roberts, M.B.E., M.I.Mech.E.
DEPUTY EDITORS: D. Fisher, Ph.D., B.Sc., A.M.I.C.E., A.M.I.Mech.E.
E. P. Ward, M.A., A.M.I.Mech.E.
DEPARTMENT EDITORS:
Design: W. L. Morse, B.Sc. (Eng.), A.M.I.Mech.E., A.F.R.Ae.S., A.F.I.A.S.
Metals and Materials: D. C. E. Gribble, B.Sc.
New Plant and Equipment: A. A. H. Scott, B.Sc., A.M.I.Mech.E.
Parliament and Institutions: J. E. Dodsworth.
Research and Development: R. A. Coffee, D.I.C., A.M.Brit.I.R.E.
MIDLANDS CORRESPONDENT: W. K. V. Gale.
EDITORIAL DESIGNER: J. T. Godfrey.
SUBSCRIPTION MANAGER: G. A. Roberts.
ADVERTISEMENT MANAGER: G. H. Dixon.
Annual subscription rates: Inland and abroad, £5 10*s* (Canada, £5 5*s*). Three months 27*s* 6*d* all countries. Single copies, 2*s* 7*d* post paid.

ENGINEERING INFORMATION SERVICE:
Assistance is available from Engineering Information Service in obtaining information, and in locating sources of information, both technical and commercial. EIS deals, for example, with names of makers and suppliers of plant and equipment, technical data on design, markets for engineering products and the compilation of references to information on specific topics. Inquiries should be addressed to Engineering Information Service, 36 Bedford Street, London, WC2.